## **Technology Selection**

and

## **Early Design Guidance**

Edited by Nick Barnard Denice Jaunzens



IEA Energy Conservation in Buildings and Community Systems Programme

Annex 28 Low Energy Cooling January 2001

## IEA Annex 28 Subtask 2: Design tools for low energy cooling Technology selection and

# early design guidance

Edited by Nick Barnard and Denice Jaunzens

This document contains two reports in a series produced by Annex 28

to assist with the design of low energy cooling systems: Selection guidance for low energy cooling technologies Early design guidance for low energy cooling technologies

The other reports are:

Review of low energy cooling technologies Detailed design tools for low energy cooling technologies Case studies of low energy cooling technologies

For further information contact:

Nick Barnard Oscar Faber Applied Research United Kingdom Tel: +44 (0)20 8784 5784 Fax: +44 (0)20 8784 5700 Denice Jaunzens Building Research Establishment Ltd United Kingdom Tel: +44 (0)1923 664522 Fax: +44 (0)1923 664095 EP56 ISBN 1 86081 458 1

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## Early design guidance for low energy cooling technologies

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#### Disclaimer

The tools and methods developed within this document have undergone validation within the country of origin to varying degrees. If you have concerns about the validity of the tools as described, in particular how they should be adapted to suit your particular modelling package or climatic conditions, please contact their creators (originators).

The information and tools are presented in good faith but it is the responsibility of users to ensure that their use is appropriate and valid for any particular design investigation. It is for the users to satisfy themselves that any results obtained from the use of the methods and tools described or referenced in this document are accurate and applicable to the particular circumstances under consideration.

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#### Preface

The International Energy Agency (IEA) was established in 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among the twenty-one IEA Participating Countries to increase energy security through: energy conservation, the development of alternative energy sources, and energy research, development and demonstration (RD&D). This is achieved in part through a programme of collaborative RD&D consisting of forty-two Implementing Agreements, containing a total of over eighty separate energy RD&D projects. This publication forms one element of this programme.

#### The Energy Conservation in Buildings and Community Systems Programme

The IEA sponsors research and development in a number of areas related to energy. In one of these areas, energy conservation in buildings, the IEA is sponsoring various exercises to predict more accurately the energy use of buildings, including comparison of existing computer programs, building monitoring, and comparison of calculation methods, as well as studies of air quality and occupancy. Seventeen countries have elected to participate and have designated contracting parties to the Implementing Agreement covering collaborative research in this area. The designation by governments of a number of private organisations, as well as universities and government laboratories, as contracting parties, has provided a broader range of expertise to tackle the projects in the different technology areas than would have been the case if participation had been restricted to governments. The importance of associating industry with government-sponsored energy research and development is recognised in the IEA, and every effort is made to encourage this trend.

#### The Executive Committee

Overall control of the programme is maintained by the Executive Committee (ExCo) and the Implementation Agreement on Energy Conservation in Buildings and Community Systems (B&CS), which not only monitors existing projects but also identifies new areas where collaborative effort may be beneficial. The Executive Committee ensures that all projects fit into a predetermined strategy, without unnecessary overlap or duplication but with effective liaison and communication. The Executive Committee has initiated the following projects to date (completed Annexes are identified by an asterisk \*):

- 1 Load energy determination of buildings\*
- 2 Ekistics and advanced community energy systems\*
- 3 Energy conservation in residential buildings\*
- 4 Glasgow commercial building monitoring\*
- 5 Air infiltration and ventilation centre
- 6 Energy systems and design of communities\*

- 7 Local government energy planning\*
- 8 Inhabitant behaviour with regard to ventilation\*
- 9 Minimum ventilation rates\*
- 10 Building HVAC systems simulation\*
- 11 Energy auditing\*
- 12 Windows and fenestration\*
- 13 Energy management in hospitals\*
- 14 Condensation\*
- 15 Energy efficiency in schools\*
- 16 BEMS 1: User guidance\*
- 17 BEMS 2: Evaluation and emulation techniques\*
- 18 Demand controlled ventilating systems\*
- 19 Low slope roof systems\*
- 20 Air flow patterns within buildings\*
- 21 Thermal modelling\*
- 22 Energy efficient communities\*
- 23 Multizone air flow modelling (COMIS)\*
- 24 Heat air and moisture transfer in envelopes\*
- 25 Real time HVAC simulation\*
- 26 Energy efficient ventilation of large enclosures\*
- 27 Evaluation and demonstration of domestic ventilation systems
- 28 Low energy cooling systems
- 29 Daylighting in buildings
- 30 Bringing simulation to application
- 31 Energy related environmental impact of buildings
- 32 Integral building envelope performance assessment
- 33 Advanced local energy planning
- 34 Computer aided fault detection and diagnosis
- **35 HYBVENT**

#### Introduction

Cooling is a significant user of energy in buildings, and its impact as a contributor to greenhouse gas emissions is enhanced by the fact that these systems are usually electrically driven. Increasing use of information technology has led to an increasing demand for cooling in the commercial buildings sector, with consequent problems for utilities companies.

In response to these issues, the IEA's Future Building Forum Workshop on Innovative Cooling (held in the United Kingdom in 1992) identified a number of technologies with the potential to reduce energy consumption in the field of alternative cooling strategies and systems, leading to the establishment of Annex 28. The emphasis for the project was on passive and hybrid cooling technologies and strategies. These require close integration of the dynamics of the building structure with the HVAC systems, and this is precisely the area in which the B&CS ExCo has established expertise.

#### Objective

Passive and hybrid cooling systems will only be taken up in practice if such systems can be shown to meet certain criteria. The objective of the Annex was to work towards fulfilling the following requirements.

- the life cycle costs (including energy, maintenance, etc) of such systems are less than 'conventional' systems;
- the level of thermal comfort provided is acceptable to the occupants in the context of their task;

- the systems are sufficiently robust to changes in building occupancy and use;
- the design concepts for such systems are well defined, and appropriate levels of guidance are available at all stages of the design process, from sketch plan to detailed plans;
- the necessary design tools are available in a form which designers can use in practice; and
- the cooling system is shown to integrate with the other systems (eg heating and ventilation), as well as with the building and control strategy.

#### Means

The project was subdivided into three subtasks relating to the three phases of researching and documenting the various cooling strategies.

#### Subtask 1: Description of cooling strategies

The aim of this subtask was to establish the current state of the technologies in the participating countries. The findings are detailed in the report: *Review of low energy cooling technologies*. The report also contains national data for climate, building standards, heat gains, comfort criteria, energy and water costs for each of the participating countries.

#### Snbtask 2: Development of design tools

Different levels of tool are required throughout the design process. Initially little detailed data will be available and the emphasis will be on tools using 'rules of thumb'. When suitable options have been established, approximate performance data and practical guidance will be needed for early design and assessment. Finally, when the broad principles of the design have been established, techniques such as simulation modelling can be used for detailed design and optimisation. To reflect these requirements, three different levels of tool have been developed by the Annex:

Selection guidance for low energy cooling technologies (included in this publication)

This tool provides guidance on the initial selection of suitable low energy technologies. Paper and software (Visual Basic) versions of the tool have been produced.

• Early design guidance for low energy cooling technologies (included in this publication)

A collection of simplified tools based on design charts and tables, and practical guidance, to assist with early design development of a technology.

 Detailed design tools for low energy cooling technologies A report on a collection of tools for use as part of, or in conjunction with, simulation software.

#### Subtask 3: Case studies

The third element of the work was to illustrate the various cooling technologies through demonstrated case studies. Approximately twenty case studies have been documented in the Annex report *Case studies of low energy cooling technologies*. The case studies give feedback on performance and operation in practice and include design details and monitored performance data.

#### Scope

A number of different technologies have been considered by the Annex. The table gives an overview of which of the Annex reports have information on which of the technologies.

Low energy cooling technologies included in Annex reports							
			Early	Detailed			
		Selection	design	design	Case		
Technology	Review	guidance	guidance	tools	studies		
Night cooling (natural	<u> </u>			<u></u>			
ventilation)	V	¥		<ul> <li></li> </ul>	<u>&lt;</u>		
Night cooling (mechanical							
ventilation)	¥	<ul> <li>✓</li> </ul>	¥	¥	<u> </u>		
Slab cooling (air)	<b>~</b>	<ul> <li></li> </ul>		V			
Slab cooling (water)	<ul> <li>Image: A start of the start of</li></ul>	<b>~</b>	<ul> <li></li> </ul>	<ul> <li></li> </ul>			
Evaporative cooling (direct							
and indirect)	×	<b>~</b>	¥	<ul> <li>Image: A start of the start of</li></ul>	<ul> <li>Image: A start of the start of</li></ul>		
Desiccant + evaporative							
cooling	~	<ul> <li></li> </ul>		<ul> <li></li> </ul>	¥		
Chilled ceilings/beams	¥	~		_	<ul> <li>Image: A start of the start of</li></ul>		
Displacement ventilation	¥	V		¥	¥		
Ground cooling (air)	<b>v</b>	~	¥	<ul> <li></li> </ul>	V		
Aquifer	<ul> <li></li> </ul>	~		<ul> <li></li> </ul>	¥		
Sea/river/lake water cooling		<ul> <li></li> </ul>					

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#### Participation

The participating countries in this task are Canada, Germany, Finland, France, The Netherlands, Portugal, Sweden, Switzerland, the United Kingdom and the United States of America. The funding groups for each country are given below.

Canada	Buildings Group
	CANMET- Energy Technology Branch, NRCan
	580 Booth St
	Ottawa, Ontario
	K1A 0E4
	Heat Management Technologies
	Energy Diversification Research Laboratory
	1615, Montée Ste-Julie
	CP 4800
	Varennes, Québec
	J3X 1S6
Germany	Bundesministerium für Bildung Technologie und Forschung (BMBE)
	Postfach 200240
	Bonn, Germany
Finland	Technology Development Centre
	Fin - 00101 Heisinki

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France	Agence de l'environnement et de la maitrise de
	Fédération nationale du bâtiment
	Ministère de l'équipement - Plan Construction
	Centre scientifique et technique du hâtiment
	Ecole des mines de Paris
	Gaz de France
	Costic
The Netherlands	Novem BV
	Swentiboldstraat 21
	PO Box 17
	6130 AA Sittard
Portugal	Center for Energy Conservation
	Praceta à Estrada de Alfragide
	Alfragide
	2700 Amadora
	Department of Mechanical Engineering
	University of Porto
	R Bragas
	4099 PORTO Codex
Sweden	Swedish Council for Building Research
	PO Box 12866
	SE - 11298 Stockholm
Switzerland	Swiss Federal Office of Energy
	CH - 3003 Berne
United Kingdom	British Gas
	EA Technology
	Gardiner & Theobald
	Haden Young/Balfour Beatty Building
;	MEPC Investments
	Oscar Faber
	Ove Arup
	the Regions
	Building Research Establishment Ltd
United States of America	Office of Building Technologies
	US Department of Energy
	1001 Independence Avenue
	Washington DC 20585

## Selection guidance for low energy cooling technologies

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#### A software version of this tool has also been produced.

For further information contact:

Nick Barnard	Denice Jaunzens
Oscar Faber Applied Research	Building Research Establishment Ltd
United Kingdom	United Kingdom
Tel: +44 (0) 20 8784 5784	Tel: +44 (0) 1923 664522
Fax: +44 (0) 20 8784 5700	Fax: +44 (0) 1923 664095

#### Summary

The aim of Annex 28 is to investigate the feasibility of, and provide design tools and guidance on, the application of alternative cooling strategies to buildings. Outputs from the Annex include a review of the technologies, early design guidance, detailed design tools and case study descriptions. The aim of this report is to assist with the initial selection of suitable low energy cooling technologies or combinations of technologies.

The report is based on a Selection Chart to help to identify which of the technologies are likely to be suitable for a particular application on the basis of key building parameters. This is supported by Summary Sheets for each of the technologies giving a brief description and key information. These can be used to refine the selection of technologies for further consideration.

The scope is limited to the technologies included in the Annex. The report should not be used in isolation as the sole means of selecting a technology, but as a means of focusing on a few technologies which are likely to be suitable and should be considered in more detail. The selection criteria are based on broad parameters and the way in which they will influence decisions in the majority of cases. Other parameters may be important in specific cases and there may be exceptions in the way the parameters included influence decisions. This will need to be assessed by the designer for each particular design.

The information provided reflects the state of the technologies in a country or countries participating in the Annex and should not be taken as representative of the situation on a world-wide basis.

#### Introduction

The aim of this report is to assist with the initial selection of suitable low energy cooling technologies. The guidance is given in the form of a Selection Chart (page 6) to help to identify which of the technologies are likely to be suitable for a particular application. The chart is hased on feasibility (F) and suitability (S) ratings which reflect the impact of key building parameters on each of the technologies. Feasibility ratings are used to indicate if the use of a technology can generally be ruled out by a certain parameter. Suitability ratings indicate whether a parameter is likely to have a positive or negative effect on the performance or appropriateness of a technology. The chart is supported by Summary Sheets for each of the technologies, giving a brief description and key information. These can be used to refine the selection of technologies for further consideration.

To use the chart:

- 1 Highlight the parameters and associated ratings (see example on page 10). Notes are provided for each of the input parameters to help you to decide whether they are applicable or not.
- 2 Eliminate technologies that are not feasible, ie those with a -F rating.
- 3 Add the suitability (+S, -S) ratings for the remaining technologies to give an overall rating. A positive rating is favourable and a negative rating unfavourable. No rating implies no significant impact. The net S rating will give an indication of the suitability of a technology for the application: positive = high suitability, none or zero = medium suitability, negative = low suitability.

Daytime natural and mechanical ventilation are included in the chart as a lower bound to indicate where no specific cooling provision (low energy or otherwise) is required. Mechanical cooling (refrigerant compression) is included as an upper bound. No summary sheets are provided for these technologies.

It should be noted that the parameters and ratings in the chart consider selection primarily from a technical viewpoint. Other parameters such as cost

will also need to be taken into account to refine the selection. Typical cost indicators and other key information are included on the subsequent summary sheets to assist selection of options from those which are technically suitable. The costs are given relative to a conventional heating, ventilation and air conditioning (HVAC) system and include all HVAC costs:



It is emphasised that these are only indicative for use in an initial assessment. Costs can vary considerably from application to application and specific costs should be assessed as soon as possible.

The summary sheets provide a brief description of each technology as an introduction. Common applications are noted together with rule-of-thumb performance data and spatial requirements. A check zone lists favourable and unfavourable factors for a given application, and aims and requirements for the design. One common aim for low energy cooling which precedes consideration of a cooling technology is the minimisation of heat gains<sup>\*</sup>.

An important consideration is use of the technologies in combination to meet greater cooling loads or to reduce energy consumption, cost, etc. Common combination options are noted on the summary sheets. Technologies will generally work well together where they provide cooling in different ways. An example of this is ground cooling by air, which precools supply air, in combination with night cooling, which provides cooling via cool exposed surfaces in the space. Combinations are also possible where the technologies perform a different function in the cooling process. For example, ground cooling by water can provide cool water for use by chilled ceilings/ beams.

More details on the technologies are available in IEA Annex 28 Report Review of low energy cooling technologies.

<sup>\*</sup>It should be emphasised that a prerequisite of low energy cooling is minimisation of heat gains to the space. Measures which should be considered to achieve this aim include suitable building orientation and form, solar shading, optimisation of glazing areas with regard to natural light versus solar heat gain, control of artificial lighting, and localised extract from heat sources. Documents providing guidance on these issues are listed under *Further reading*.

Selection chart: template and example

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### Selection chart template

Steps: 1 Delete non-appl 2 Determine ratin negative F no F, negative S no F, zero/no S no F, positive S Magnetic S Input parame (see notes and	<pre>icable parameters. g of each technology: = low feasibility = low suitability = medium suitability = high suitability ters maps)</pre>	F/S rating Technologies	Daytime natural ventilation	Daytime mechanical ventilation	Night cooling (natural ventilation)	Night cooling (mechanical ventilation)	Slab cooling (air)	Slab cooling (water)	Evaporative cooling (direct & indirect)	Desiccant + evaporative cooling <sup>1</sup>	Chilled ceilings/beams	Displacement ventilation	Ground cooling (air)	Aquifer <sup>2</sup>	Sea/river/lake water cooling <sup>3</sup>	Mechanical cooling
Temperature	Hot		<u>نہ</u>	<u>ند</u>	1	<u>د</u>	Ч-						·S	-S		\$ <del>1</del>
	Warm		S-	-S	-S	-S		_								
	Cool						S+	S+	S+				S+			
Humidity	Humid								-F							+S
	Semi - humid															
	Dry								S+	Ş						
Noisy/Polluted ai	r		·-Ε		Ч.				Í							
Ground pollution													-Е			
Residential			+S4		+S4						S-			S-	-S	
Retrofit							-E2	-S7					-Sé			
Limited floor/cciling height		S-		-S							S-					
Deep plan/cellular space		ц.		-F												
Heavyweight				+S	S+	<b>s</b> +	+S <sup>s</sup>									
Limited solar protection/High solar gains		-S	ş	-S	ş	Ņ	Ŷ	Ŷ		s+		-S	<b>s</b>	S+	S <sup>+</sup>	
High internal gain	15		-S	Ņ	-S	Ŷ	s'	Ŷ	ş		<b>S</b> +		s-	S+	S+	S <sup>+</sup>
Close temperatur	e control		<u>'-</u> ,	<u>11</u>	<u>17</u>	4	<u>17</u>	<u>tr</u>	Ľ,	s-	ې ۲	ې.	-S			s +S
Close humidity c	ontrol		-F	- E	<u>د.</u>	Ц	<u>در</u>	<u>ц</u>	4	ц.	Ŷ	-S	S-			s +

Note 1: Applications limited by availability of low cost heat source.

 $Note 5: \quad Applies to hollow core systems. Other approaches suitable for retrofitting are under development.$ 

Note 6: Applies to ground cooling systems installed under buildings. In some applications it may be possible to install the system beneath adjacent ground.

Note 7: Not applicable if system already installed for heating.

Note 2: Geographic restrictions represence of aquifer.

Note 3: Geographic restrictions re location near sea/river/lake.

Note 4: Natural ventilation is particularly suited to residential applications due to low cost.

Note 8: Use of slab cooling — water requires exposure of the slab and so the space will be heavyweight.

## Notes for input parameters

### Input parameters (also see temperature and humidity maps)

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Temperature	Hot	$SDT^9 > 28^{\circ}C \text{ and } SNT^{10} > 20^{\circ}C.$					
	Warm	SDT <sup>9</sup> > 28°C and SNT <sup>10</sup> < 20°C.					
	Cool	SDT <sup>9</sup> < 28°C and SNT <sup>10</sup> < 20°C (eg UK).					
Humidity	Humid	MC <sup>11</sup> > 0.014 kg/kg.					
	Semi - humid	MC <sup>11</sup> < 0.014 kg/kg and WBD <sup>12</sup> < 8 K (eg UK).					
	Dry	MC <sup>11</sup> < 0.014 kg/kg and WBD <sup>12</sup> > 8 K.					
Noisy/Polluted a	air	Relative to desired internal environment.					
Ground pollution		Eg Radon.					
Residential		Less stringent comfort criteria likely to apply, smaller scale of development.					
Retrofit		Space restrictions probable.					
Limited floor/ce	zling height	Reduces effectiveness of natural ventilation and displacement ventilation (~2.7 m minimum).					
Deep plan/cellu	lar space	Depth reduces effectiveness of natural ventilation (maximum ~7.5 m for single sided vent, ~15 m for cross vent). Cellular arrangement impedes air movement.					
Heavyweight		Eg exposed soffit or floor.					
Limited solar protection/High solar gains		Window solar factor* window area/floor area > 0.15 (typical solar factors; clear glazing ~0.8; solar control glass ~0.5 ; external shading ~0.2).					
High internal gains		Internal design gains from occupants + equipment + lighting > 30W/m <sup>2</sup> .					
Close temperatu	ire control	Eg design criteria 22+/-2°C.					
Close humidity control		Eg design criteria 40-70 %RH.					

Note 9: SDT is the summer peak design temperature (°C).

Note 10: SNT is the summer night minimum design temperature corresponding to summer peak design temperature (°C).

Note 11: MC is the summer design moisture content (kg/kg dry air).

Note 12: WBD is the wet bulb depression, the difference between the summer design ambient dry and wet bulb temperatures

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### **Temperature maps**

#### European temperature map

Summer temperature zones

This map is based on ASHRAE 0.4% annual temperature data. It has been produced to provide initial guidance only and contains some simplifications — a specific assessment will need to be made by the designer for the particular location. Refer to Selection Chart for zone classifications.

Note: Night minimum design temperature taken as day peak design temperature — mean daily range.

#### so's warm so's coor bo's coor coor

#### European humidity map

Summer humidity zones

This map is based on ASHRAE 0.4% annual humidity data. It has been produced to provide initial guidance only and contains some simplifications — a specific assessment will need to be made by the designer for the particular location. Refer to Selection Chart for zone classifications.

#### SS'N SS'N SEAN-RUMID SEAN-RUMID SEAN-RUMID SEAN-RUMID DRY HUMID DRY HUMID DRY BUMID BUMID

This map is based on ASHRAE 0.4% annual temperature data. It has been produced to provide initial guidance only and contains some simplifications — a specific assessment will need to be made by the designer for the particular location. Refer to Selection Chart for zone classifications.

Note: Night minimum design temperature taken as day peak design temperature — mean daily range.

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#### North American temperature map

Summer temperature zones



#### This map is based on ASHRAE 0.4% annual humidity data. It has been produced to provide initial guidance only and contains some simplifications — a specific assessment will need to be made by the designer for the particular location. Refer to Selection Chart for zone classifications.

#### North American humidity map

Summer humidity zones



Evaporative cooling (direct & indirect)

Slab cooling (water)

Slab cooling (air)

Desiccant + evaporative cooling<sup>1</sup>

Chilled ceilings/beams Displacement ventilation

Ground cooling (air)

Aquifer<sup>2</sup>

Sea/river/lake water cooling<sup>3</sup>

Mcchanical cooling

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Night cooling (mechanical ventilation)

Night cooling (natural ventilation)

Daytime mechanical ventilation

Daytime natural ventilation

Technologies

### Selection chart example

A new commercial development in the UK in a noisy urban environment. Construction will be heavyweight plan. Reasonable solar protection will be provided but internal heat gains will be  $\sim 35 \text{ W/m}^2$ . Close temperature/ humidity control is not required.

#### Steps:

- Highlight applicable parameters: cool climate, semi-humid climate, noisy/polluted air, heavyweight, high internal gains.
- 2 Identify technologies with highlighted feasibility (-F) ratings; daytime natural ventilation, night cooling (natural).
- 3 Add highlighted suitability (+S, -S) ratings for remaining technologies.

ratings for remai	ning technologies. ers maps)	4	-S-	۴		S+	S+			S+			S+	S+	÷+
Temperature	Hot	ц,	Ŀ.	٦	<u>ب</u>	<u>ц</u>						-S	S-		<u>נ</u> י
	Warm	-S	Ņ	-s	-s										
	Cool					///	///	///				VK.			///
Humidity	Humid							Ц							ŝ
	Semi - humid	1//	///			///	///	///				///	(//		11
	Dry							+S	S-						
Noisy/Polluted a	ir	4	<i>[]]</i>	(4)	///	///	///	///	///			///			[];
Ground pollution												4			
Residential		+S4		+S+						-s			-s	-S	
Retrofit						-F5	-S1					-S6			
Limited floor/cci	ling height	-s		s.							s'				
Deep plan/cellula	ur space	-F		ų											
Heavyweight				[]]	[]]	k				///	///				//
Limited solar protection/High solar gains		ŝ	-s	s'	-s	S-	-S	-S		S+		۰. م	+S	+S	S+
High internal gains		4	///	///	///		[]/]	V/				14			1×1
Close temperature control		ц	ų	4	ц	ц	-F	4	Ŷ	Š	-s	Ņ			ŝ
Close humidity c	ontrol	Ľ,	ц.	Ľ,	<u>ц</u>	μ,	Ψ,	-F	4. <b>[1</b> ]	S-	-S	Ś			ŝ

Note 1: Applications limited by availability of low cost heat source.

Note 2: Geographic restrictions re presence of aquifer.

Note 3: Geographic restrictions relocation near sea/river/lake.

Note 4: Natural ventilation is particularly suited to residential applications due to low cost.

Note 5: Applies to hollow core systems. Other approaches suitable for retrofitting are under development,

Note 6: Applies to ground cooling systems installed under buildings. In some applications it may be possible to install the system beneath adjacent ground.

Note 7: Not applicable if system already installed for heating.

Note 8: Use of slab cooling --- water requires exposure of the slab and so the space will be heavyweight.

# Summary sheets

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### Night cooling (natural ventilation)

#### Description

Air flow is introduced into the building at night by opening windows/vents. Operation of windows/vents can be manual or automatic. As the air circulates, it comes into thermal contact with and cools the exposed building fabric in the occupied zone. The cool exposed surfaces will offset heat gains the following day.

#### Applications

Most new and retrofit buildings with low sensible cooling loads, in particular those with periodic loads such as offices. May be unsuitable in cities due to air and noise pollution. Security and privacy concerns could also hinder application.

#### Benefits

- Very low capital and operating cost.

#### Typical cost indicators (relative to a conventional HVAC system)

Capital

- Very low, but cost may be incurred in other areas, eg provision of special shutters/windows/vents, automating operation, wind towers etc

Operation - Energy

- Very low

Operation - Maintenance

- Very low, although some will be required for automatic opening devices and additional cleaning may be needed in urban areas

Favourable factors - Cool climate - Periodic loads	Unfavourable factors - Hot climate - External noise and air pollution - Limited floor/ceiling height - Deep plan/cellular space - High heat gains - Close temperature/humidity control
CHECK	<b>Design requirements</b>
Design aims	- Effective air/fabric thermal linking
- Cross ventilation air flow	- Openable windows or equivalent
- Avoid overcooling	- Security and privacy

#### Performance (cool climate)

Night cooling of heavyweight constructions will offset in the region of 20 to 30 W/m<sup>2</sup> of heat gains. Corresponding internal peak space temperature reductions are of the order of 2 to 3 K. Performance will be reduced for lightweight constructions with little exposed mass.

#### Spatial considerations

- Exposed mass.
- Ventilation openings in facade.
- Unobstructed air flow paths.

#### Combinations with other technologies

- Night cooling (mechanical ventilation) to boost cooling during peak periods.



### Night cooling (mechanical ventilation)

#### Description

Fans are used to circulate cool ambient air through the building space overnight. As the air circulates, it comes into thermal contact with and cools the exposed building fabric in the occupied space. The cool exposed surfaces will offset heat gains the following day. (See also slab cooling - air where heat transfer takes place between the air and the slab in dedicated air paths to pre-cool the supply air.)

#### Applications

Most new and retrofit buildings with low sensible cooling loads, in particular those with periodic daily loads such as offices.

#### Benefits

- Low capital and operating costs.

#### Typical cost indicators (relative to a conventional HVAC system)



Operating - Energy

- Low for system (supply + extract) pressure drops < 1000 Pa, high for pressure drops > 1500 Pa

Operating - Maintenance

- Low





#### Performance (cool climate)

Night cooling of heavyweight constructions will offset in the region of 20 to 30 W/m<sup>2</sup> of heat gains. Corresponding internal peak space temperature reductions are of the order of 2 to 3 K. Performance will be reduced for lightweight constructions with little exposed mass.

Cooling to fan energy ratio is approximately inversely proportional to system (supply + extract) pressure drop, and is typically  $\sim 3 @ 1000$  Pa.

#### Spatial considerations

- Exposed mass.

- Ventilation system including fans, distribution ductwork, diffusers, etc.

- Displacement ventilation to reduce temperatures in the occupied zone.
- One of the following to pre-cool the daytime supply air, ground cooling (air); evaporative cooling (direct and/or indirect); desiccant + evaporative cooling; slab cooling (air).

### Slab cooling (air)

#### Description

The supply air is passed through dedicated air paths to bring it into thermal contact with the slab before entering the occupied space. High rates of air/slab heat transfer (and therefore charging/discharging of cooling) can be achieved in a number of ways. One is to use the cores in the slabs as ducts for the air supply. During the summer, the cool night air is passed through the slabs to lower their temperature. This stored cooling is then released the following day by using the slabs to pre-cool the supply air. The lower surface of the slab is also often exposed to provide direct heat exchange with the occupied space (see night cooling - mechanical ventilation).

#### Applications

New buildings with moderate sensible cooling loads, in particular those with periodic loads such as offices.

The hollow core approach is restricted to new applications. (Other approaches suitable for retrofitting are under development.)

#### Benefits

- Low capital and operating cost.

#### Typical cost indicators (relative to a conventional HVAC system)

- 🗅 Capital
- Low
  - Operating Energy
    - Low for system pressure drops < 1000 Pa, high for pressure drops > 1500 Pa
  - Operating Maintenance
    - Low

Favourable factors - Cool climate - Periodic loads	Unfavourable factors - Hot climate - High internal gains - Close temperature/humidity control
Design aims	Design requirements
Minimice system messure door	- Effective air/slab thermal linking
- Minimise system pressure drop	
<ul> <li>Avoid overcooling at night</li> </ul>	<ul> <li>Access for cleaning and maintenance of</li> </ul>
- Use slab for beat storage in winter	airways
- Ose shap for that storage in winds	
	- Space for vernilation system

#### Performance (cool climate)

Systems can generally keep peak internal space temperature below ambient for heat gains up to  $\sim 40 \text{ W/m}^2$  without exposed lower slab surface,  $\sim 60 \text{ W/m}^2$  with an exposed lower slab surface.

Cooling to fan energy ratio is approximately inversely proportional to system (supply + extract) pressure drop, and is typically  $\sim 3$  @ 1000 Pa.

#### Spatial considerations

- Possible increase in slab depth or floor void to incorporate air paths.
- Ventilation system including fans, distribution ductwork, diffusers, etc.

- Displacement ventilation to reduce temperatures in the occupied zone.
- Night cooling (mechanical ventilation) to provide space cooling.
- Mechanical cooling to meet peak loads.



### Slab cooling (water)

#### Description

A pipe network is typically embedded in the slab itself or in a floating slab ~70 mm thick and located on the bearing slab. Water is circulated through the pipework from a cooling source such as a cooling tower or a heat pump, etc. The cooling is stored in the slabs. Cooling of the space is via heat transfer from the top or bottom surface of the slab. The system can also be used for heating in winter.

#### Applications

Best suited to new buildings with moderate sensible heat gains. It provides sensible cooling only and so is not suitable for climates with high humidity.

#### Benefits

- Low capital and operating costs.

#### Typical cost indicators (relative to a conventional HVAC system)

- Capital
  - Similar (low when utilising system for heating as well)
- Operating Energy
- Low
  - Operating Maintenance

- Low



Favourable factors - Low energy/quality source of cooling - Ability to use system for heating in winter	Unfavourable factors - Hot climate - High heat gains - Close temperature/humidity control
<b>Design aims</b> - Avoidance of condensation problems - Surface/air temp. differential < 4 K	<b>CZONE</b> <ul> <li>Design requirements</li> <li>Pipework connections accessible</li> <li>Effective slab/air thermal linking</li> <li>Space for central cooling and distribution system</li> </ul>

#### Performance

Cooled floors30 to 40 W/m² with cooling water @ 22°C occupied space @ 26°CCooled ceilings40 to 50 W/m² with cooling water @ 20°C occupied space @ 26°C

(NB A larger radiant temperature asymmetry is tolerable with cooled ceilings than floors giving a higher cooling capacity.)

The ratio of cooling produced to energy for generation and distribution will primarily depend on the source of cooling utilised.

#### Spatial considerations

- Exposed slab surface.
- Central cooling plant and distribution system including pumps, pipework and cooling source (eg cooling towers, ground cooling water, sea water cooling, mechanical cooling.)

- Low energy/quality sources of cooling including cooling towers, aquifer and sea/river/lake water cooling.
- Mechanical cooling, possibly utilising a low energy source for condenser cooling, eg aquifer or sea/river/lake water cooling.
- Displacement ventilation with cooled ceilings to reduce temperatures in the occupied zone.
- One of the following technologies to pre-cool the supply air; slab cooling (air); ground cooling (air).

#### Evaporative cooling (direct and indirect)

#### Description

Water is evaporated in non-saturated air to produce a drop in dry bulb temperature and an associated rise in the moisture content. Direct evaporative cooling is where this takes place in the supply airstream. The indirect approach cools the exhaust airstream. This air then sensibly cools the supply air via an air-to-air heat exchanger (which can also be used for heat recovery in winter). The two approaches can be used in isolation or in an indirect/direct combination.

#### Applications

New or retrofit buildings with low internal gains. (Also used to pre-cool condenser air.)

#### **Benefits**

- Low cooling energy cost.
- Low capital cost.
- High fresh air flow rates give good ventilation.

#### Typical cost indicators (relative to a conventional HVAC system)

- Capital
  - Low
  - Operating Energy
  - Low, small amount of extra fan and pump power plus water consumption
  - Operating Maintenance

- Similar

Favourable factors - Dry climate	Unfavourable factors - Humid climate - High heat gains - Close temperature/humidity control - Legionella concern although risk limited by low water temperatures
<b>Design aims</b> - Heat recovery using heat exchanger to pre-heat outdoor air in winter	<b>Design requirements</b> - Space for ventilation system

#### Performance (dry climate)

Direct coolers	Subcooling of supply air ~80% of wet bulb depression <sup>1</sup>
	Ratio of cooling delivered to energy for generation and distribution ~7
	Water consumption ~1.3 I/MJ of cooling
Indirect/direct coolers	Subcooling of supply air ~120% of wet bulb depression <sup>1</sup>
	Ratio of cooling delivered to energy for generation and distribution ~4
	Water consumption ~1.5 MJ/l of cooling

#### Spatial considerations

- Ventilation system including fans, evaporators, distribution ductwork, diffusers, etc.

#### Combinations with other technologies

- Night cooling (mechanical ventilation) to provide space cooling.
- Displacement ventilation to reduce temperatures in the occupied zone.
- Mechanical cooling to meet peak loads.





The wet bulb depression is the difference between the ambient dry and wet bulb temperatures.

#### **Desiccant and evaporative cooling**

#### Description

Moisture in the supply air is removed by a desiccant material in the dehumidifier. During dehumidification heat is released increasing the dry bulb temperature. The dry bulb temperature is then reduced by heat exchange with the exhaust air followed by auxiliary direct evaporative cooling.

The desiccant can either be solid or liquid.

#### Applications

Best suited to new and retrofit buildings where low cost heat energy is available.

#### Benefits

- Use of alternative energy sources and waste heat for regeneration.
- Load management by shifting electrical consumption to a thermal source.
- Improvement in IAQ (Indoor Air Quality) for desiccants which act as bactericides.

#### Typical cost indicators (relative to a conventional HVAC system)

Lost multators (relative to a conventional r	TVAC System)
Capital	
- High	
Operating - Energy	
- Low if waste heat or cheap thermal sour	rce available
Operating - Maintenance	
- Similar	
Favourable factors	Unfavourable factors
- Waste heat or cheap thermal source	<ul> <li>Close temperature/humidity control</li> </ul>
available	- Dry climate
CHE	CK ZONE
Design aims	Design requirements
- Air filters to increase life span of	- Space for ventilation system
dchumidifier	- Supply and extract airstreams normally
	adiacent

#### Performance

Overall ratios of cooling output to regeneration and ancillary energy input of about 1 are achievable at present. Development of advanced desiccant materials and improved cycles may give ratios above 1.7. (NB These values should be seen in the context of use of alternative energy sources/waste heat and the low dew point temperatures which can be achieved.) Performance of auxilliary evaporative cooler will typically be as detailed under evaporative cooling. Example delivered cooling performance figures for a gas driven unit in a warm semi-humid climate are gas CoP = 2.6, electrical CoP = 11.6.

#### Spatial considerations

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- Ventilation system including fans, desiccant device, evaporators, distribution ductwork, diffusers, etc.

#### Combinations with other technologies

- Night cooling (mechanical ventilation) to provide space cooling
- Displacement ventilation to reduce temperatures in the occupied zone.
- Evaporative cooling of the reactivation airstream, reducing the requirement for auxiliary cooling but increasing the amount of heat needed for reactivation.

#### Specialist Applications

Desiccant cooling with mechanical rather than evaporative auxiliary cooling is applicable as a low energy cooling option in specialist applications where low humidity or separate control of temperature and humidity is required eg ice rinks, supermarkets, etc.



## Chilled ceilings/beams

#### Description

The cooling units are often integrated with false ceilings. Cooling is provided by circulating cool water ( $\sim 16^{\circ}$ C) through the units. Chilled ceilings have flat panel units which transfer cooling to the space primarily by radiation. Chilled beams have a more open structure and rely on convective air movement as the principle mechanism for heat transfer.

#### Applications

New and retrofit buildings with medium internal gains.

#### Benefits

- Can be used in conjunction with a low quality source of cooling due to the relatively high cooling water temperature.
- Cooling supplied within the space limiting the requirements of the ventilation system to providing fresh air, so reducing plant and ductwork space requirements and fan energy consumption.

#### Typical cost indicators (relative to a conventional HVAC system)

- Capital - High Operating - Energy - Low
- Operating Maintenance
- Similar



Favourable factors - Low energy/quality source of cooling	Unfavourable factors - Close temperature/humidity control
<b>Design aims</b> - Avoidance of condensation problems	<b>Design requirements</b> - Space for cooling elements - Space for central cooling and distribution system

#### Performance

Chilled ceilings ~40 W/m<sup>2</sup> typically assuming 50% active area with cooling water @16°C occupied space @ 26°C

Chilled beams ~60 W/m<sup>2</sup> typically with cooling water @16°C occupied space @ 26°C

The performance of both is approximately proportional to cooling water/occupied space temperature differential. Output from chilled beams can vary considerably with design.

Overall cooling Coefficient of Performance (CoP) will be dependent on cooling source selected.

#### Spatial considerations

- Chilled ceilings/beams.
- Central cooling plant and distribution including pumps, pipework and cooling source (eg cooling towers, ground cooling water, sea/river/lake water cooling, mechanical cooling).

- Displacement ventilation to reduce temperatures in the occupied zone and to provide fresh air and humidity control with chilled ceilings. (NB Interaction of chilled beams with displacement ventilation not established.)
- One of the following technologies to pre-cool the supply air; slab cooling (air); ground cooling (air).
- Low energy/quality sources of cooling including cooling towers, aquifer and sea/river/lake water cooling.
- Mechanical cooling, possibly utilising a low energy source for condenser cooling, eg aquifer or sea/river/lake water cooling.

### **Displacement ventilation**

#### Description

Displacement ventilation is buoyancy driven air movement rather than forced as is the case for conventional mixed ventilation systems. Cool air is gently introduced into the conditioned space at low level. This spreads slowly across the space, providing a source of cool air for convective plumes which form around local heat sources. The plumes spread out below the ceiling to form a warm stratified layer from which the air is extracted.



#### Applications

Most new and retrofit buildings with moderate cooling loads.

Higher cooling loads are often met by using in combination with chilled ceilings.

#### Benefits

- Higher air supply/extract temperatures than for conventional mixed systems can reduce cooling energy consumption.
- More effective removal of contaminants than for conventional mixed systems because removal is direct rather than via. dilution.

#### Typical cost indicators (relative to a conventional HVAC system)



Favourable factors - Surface temperature of heat sources >35°C	Unfavourable factors - Close temperature/humidity control - Strong disturbances to air flows from eg movements or downdrafts
CHECK	ZONE
Design aims	Design requirements
- Supply air temperature >18°C	-Large floor to ceiling height required ie
- Space vertical temp. gradient <1.5 K/m	>2.7 m
Space vertical temp, gradient \$1.5 tem	
	- Space for low velocity air terminal devices
	at low level

#### Performance

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Capacity limited to 30 to 40  $W/m^2$  by maximum tolerable vertical temperature gradient in the occupied zone. (NB Higher gains could be met if a significant proportion are at high level out of the occupied zone eg lights.) Often used in conjunction with chilled ceilings to meet higher cooling loads. In these applications the primary function of the displacement ventilation is normally to provide fresh air and humidity control.

Displacement air flow systems will typically reduce effective occupied space temperature by ~1 K (equivalent to offsetting ~5 W/m<sup>2</sup> of heat gains) in comparison with conventional mixed systems.

#### Spatial considerations

- Large floor to ceiling height, > 2.7 m
- Low velocity air terminal devices.

- One of the following to provide space cooling; night cooling (mechanical ventilation); chilled ceilings interaction with chilled beams not established; slab cooling (water).
- One of the following to pre-cool the supply air; ground cooling (air); evaporative cooling (direct and/or indirect); desiceant + evaporative cooling; slab cooling (air); aquifer cooling; sea/river/lake water cooling; mechanical cooling.

### Ground cooling (air)

#### Description

Outside air is drawn through an underground piping system by the ventilation plant. Heat transfer from the ground provides pre-cooling in the summer and pre-heating in the winter.

#### Applications

New mechanically ventilated buildings with suitable ground conditions. Best suited to office buildings with a moderate cooling demand.



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#### **Benefits**

Reduces peak demand for cooling and heating. This produces lower energy and installation costs for the rest of the HVAC system.

#### Typical cost indicators (relative to a conventional HVAC system)

Capital - High (to low for residential buildings) Operating - Energy - Low Operating - Maintenance - Low	
Favourable factors - Ground temperature 12°C or lower - Located in sand/gravel + below water level - Moving ground water	Unfavourable factors - Hot climate - Rocky ground - Ground pollution eg radon - High heat gains - Close temperature/humidity control
CHECK Design aims - Insulate the system from building heat gains - Minimise piping system pressure drops	<b>Design requirements</b> - Space requirement for piping system - Access requirements for maintenance - Sealing in wet ground

#### Peak

- Cooling with ambient air @ 32°C
- Heating with ambient air @ -5°C
- Seasonal
- Cooling
- Heating

45 W/m<sup>2</sup> of ground coupling area 45 W/m<sup>2</sup> of ground coupling area

#### 8-10 kWh/m<sup>2</sup> of ground coupling area 10-15 kWh/m<sup>2</sup> of ground coupling area

#### Spatial considerations

- Ground cooling system, typically at 5 m depth, area a function of output as noted under performance.

- Access to ground cooling system.

- Displacement ventilation to reduce temperatures in the occupied zone.
- One of the following to provide space cooling; night cooling (mechanical ventilation); chilled ceilings/beams; slab cooling (water) - cooled ceiling.

### Aquifer

#### Description

The basic system consists of two well sets drilled in the sand bed. Water is pumped from one well set to the other in summer with cooling extracted via a heat exchanger. This cooling can either be used directly to cool the space/supply air, or indirectly as condenser water.

The cycle is reversed in winter with the extracted heat normally used to warm the ventilation supply air.

#### Applications

New and retrofit buildings with gross areas in excess of  $6,000 \text{ m}^2$  with a suitable aquifer between 30 m and 200 m in depth limited by tight layers of clay or a similar type of soil material.

#### Benefits

- Low cooling energy cost.

#### Typical cost indicators (relative to a conventional HVAC system)

- High (to similar for small systems)

Capital

Operating - Energy

- Low Operating - Maintenance

Operating - Maintena

- Similar



Favourable factors - Aquifer of sand or limestone bounded by tight layers of clay or similar soil material - Climates with a heating <u>and</u> cooling season for interseasonal storage CHECK	Unfavourable factors - Hot climate - Taxes or restrictions on ground water use - Moving ground water compromising interseasonal storage
<b>Design aims</b> - Balance heating and cooling extracted	Design requirements - Cold and warm well sets should be 100 to 150 m apart - Space for heat exchanger etc

#### Performance (cool climate)

Cool wells remain between 6 to 10°C, producing cooling water @~12°C in Summer Warm wells remain between 12 to 22°C, producing heating water @~10°C in Winter Water extraction typically ~25 l/s per well pair giving a peak capacity of ~900 kW cooling Seasonal cooling storage per well pair ~1000 kWh/annum Ratio of cooling produced to energy for generation (not distribution) ~10.

#### Spatial considerations

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- Ground cooling system with cold and warm well sets 100 to 150 m apart, depth typically 30 to 200 m, size typically  $1.5 \times 1.5$  m, number of wells is a function of output as noted under performance.
- Heat exchanger, circulating pumps, distribution pipework etc.

- One of the following technologies to use the low quality cooling to directly cool the space; chilled ceilings/beams; slab cooling (water).
- Displacement ventilation to reduce temperatures in the occupied zone.
- Mechanical cooling using the low quality cooling water as condenser water.

### Sea/river/lake water cooling

#### Description

Water is pumped from the depths by an open loop system and cooling extracted via a heat exchanger. This cooling can either be used directly to cool the space/supply air, or indirectly as condenser water. In winter, warm water returning to the heat exchanger can be used to pre-heat incoming fresh air.

#### Applications

New and retrofit buildings with moderate cooling loads which are located near sea/river/lake with low temperatures.

#### Benefits

- "Free" cooling can be provided by the cold water source for most of the year.
- Low operating cost.

#### Typical cost indicators (relative to a conventional HVAC system)

- 🖌 Capital
  - High (but can be lower depending on system size and availability)
  - Operating Energy
    - Low
    - Operating Maintenance
      - Similar

Favourable factors - Proximity to cold water source CHECK	Unfavourable factors - Hot climate - Great depth required to reach cold water - Salinity in sea water encouraging corrosion in equipment
Design aims - Minimise cold water source pumping costs - Eliminate corrosion and fouling possibilities - Compatibility with mechanical cooling	Design requirements - Space for heat exchanger etc

#### Performance

Effective direct cooling occurs only when intake temperatures are below 10°C. Lower intake temperatures may not be sufficient however when building cooling loads are high and heat transfer rates are constrained by pumping capacities. Indirect cooling of condensers in conjunction with mechanical cooling is effective provided intake temperatures remain below 13°C.

Cathodic protection is often used as a means to impede marine growth and corrosion in equipment.

#### Spatial considerations

- Heat exchanger, circulating pumps, distribution pipework etc.

#### Combinations with other technologies

- One of the following technologies to use the water to directly cool the space; chilled ceilings/beams; slab cooling (water).
- Mechanical cooling using the cool water as condenser water.
- Displacement ventilation to reduce temperatures in the occupied zone.



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IEA Annex 28 Subtask 2 Report 2

## Early design guidance for low energy cooling technologies

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#### Summary

The aim of Annex 28 is to investigate the feasibility of, and provide design tools and guidance on, the application of alternative cooling strategies to buildings. Outputs from the Annex include a review of the technologies, design tools and case study descriptions. This report is a compilation of guidance developed for use during early design. The guidance has been contributed by the individual member countries participating in the Annex.

The guidance is based on design charts and tables and practical information. The type of guidance varies hetween the technologies as appropriate, depending on their type and state of development. For example, the guidance for night cooling is predominantly design charts and tables as the equipment and construction techniques used are well established. This is not the case for a technology like ground cooling (air) for which a considerable amount of practical guidance has been provided.

The content of the chapters is as follows.

Chapter A The applicability of evaporative cooling in commercial office buildings Tabulated maximum temperatures, percentage hours undercooled and electricity consumption (fans and cooling) for 14 system configurations and 24 climates. Generated by DOE software.

Chapter B Evaporative cooling in office buildings Tabulated peak temperatures/cooling coil loads under summer design conditions plus annual energy (heating, cooling and fan) and water consumptions per annum for French climates Trappes, Carpentras and Nice. Generated by COMET thermal software.

#### Chapter C Slab cooling system with water

Charts for estimating the cooling provided in combination with a cooling tower based on indoor plus outdoor dry and wet bulb temperatures.

#### Chapter D Night cooling ventilation in UK commercial buildings Design curves to predict peak temperatures, free cooling provided and fan energy consumption for south-east UK climate. Generated by IES FACET software.

# Chapter ENight cooling in residential buildingsTabulated data to establish minimum solar protection required tolimit peak temperatures for four French climates.Generated by COMET thermal software.

#### Chapter F Ground coupled air systems Design curves for capacity and sizing of simple systems based on

Detailed Design Tool documented in IEA Annex 28 Subtask 2 Report 3. Practical installation guidance.

#### Introduction

This report is a compilation of guidance for low energy cooling technologies intended for use during early design. It constitutes part of the output of the IEA's project Annex 28 in fulfilling its aim to provide design tools and guidance on the application of alternative cooling strategies to buildings. Guidance has also been developed by the Annex to assist with technology selection prior to early design (Report 1, which is included in this publication). Detailed design tools have been developed for the detailed design and simulation. A review of the technologies and case study descriptions have also been produced (see Preface).

The guidance is hased on design charts and tables and practical information. The type of guidance varies between the technologies as appropriate depending on their type and state of development. For example, the guidance for night cooling is predominantly design charts and tables as the equipment and construction techniques used are well established. This is not the case for a technology like ground cooling (air) for which a considerable amount of practical guidance has been provided.

Where design charts and tables have been provided, the data for these have generally been generated by simulation using the Detailed Design Tools documented in Annex 28 Subtask 2 Report 3. In some cases, the data have been generated only for the climate of the guidance originator. In these cases it may be that other Annex Participants have produced data for their own climates.

The tools all contain the following parts:

- 1 Introduction a brief description of the technology and the tool
- 2 Parameters definition of assumptions made for generating the design guidance
- 3 Design charts or tables the design guidance

Other parts have been added to tools as necessary to cover practical guidance, references, etc.

## **Chapter A**

## The applicability of evaporative cooling in commercial office buildings

Developed	by:
Name:	Yu Joe Huang
Organisation	: Simulation Research Group
Address:	Environmental Energy
	Technologies Division
	Lawrence Berkeley National.
	Laboratory
	Berkeley CA 94720 USA
Phone:	(510) 486 7082
Fax:	(510) 486-4673
E-mail:	YJHuang@lbl.gov

#### 1 Introduction

To determine the applicability of evaporative cooling in commercial office buildings, computer simulations were done using the DOE-2.1E program<sup>[1]</sup> for various evaporative cooling systems as either stand-alone systems or precoolers for air-conditioning systems in a range of building conditions and climate variations. The performance of the evaporative cooling system was evaluated in terms of both comfort conditions and electricity use as compared with a standard air-conditioning system.

The results are presented as a set of tables showing the maximum indoor temperatures, percentage of annual hours undercooled, and the electricity consumption for cooling and fans for 14 system configurations (nine standalone, four precooling, and one conventional packaged variable-air-volume system) and 12 building variations (two levels of internal gains, two thermal mass conditions, three solar apertures). Twenty-four climate conditions have been studied, 14 in North America (11 in the US and three in Canada) and ten in Europe (two in Portugal, three in France, and one each in the UK, The Netherlands, Switzerland, Germany and Finland).

#### 2 Parameters

The intent of the study is to provide guidelines on the general applicability of evaporative cooling by climate for a range of typical building conditions and operating conditions, rather than to analyse any particular building or control strategy in depth. The typical prototype building is a 1858 m<sup>2</sup> office building of either two or three floors, modelled as ten zones (five perimeter zones and one core zone on each floor).

#### Solar aperture

Three levels of solar gain are studied:

- low (30% window-to-wall ratio, 0.70 shading coefficient), medium (30% window-to-wall ratio, 1.0 shading coefficient), and
- high (60% window-to-wall ratio, 1.0 shading coefficient).

The windows are modelled as either single or double pane depending on location.

#### Internal gains

- Two levels of internal gains are studied:
  - high  $(39 \text{ W/m}^2 \text{ for lights}, 11 \text{ W/m}^2 \text{ for equipment})$ , and
  - low (16 W/m<sup>2</sup> for lights and 5 W/m<sup>2</sup> for equipment).

The hourly schedules for lights, electrical equipment, and occupants are shown in Figure 1.
#### Thermal inertia

Two conditions of thermal mass are considered:

- high, representing a heavy concrete construction with 30 cm concrete masonry walls, 20 cm heavy concrete floors, and a floor weight of  $636 \text{ kg/m}^2$ , and
- light representing a light steel-frame construction with 15 cm lightweight walls, 10 cm lightweight concrete floors and a floor weight of 150 kg/m<sup>2</sup>.

#### Occupancy and shell thermal integrity

The occupant density and level of thermal integrity of the building have been varied by location based on government survey data for the US<sup>[2]</sup> or Appendix B of the IEA Annex 28 Subtask 1 report for other countries<sup>[3]</sup>. These are summarised in Table 1.





Table 1 Occupa	ncy and shell	thermal inte	grity for Annex	28 participat	ting countries
	Occupancy (	m²/person)	U-value (W/m	2°C)	Window
Countries	Perimeter	Core	Wall	Roof	panes
US Northeast	20	20	0.52	0.33	2
US North Central	35	35	0.40	0.24	2
US South	25	25	0.52-2.30	0.33-0.42	1
US West	33	33	0.47-1.15	0.29–0.57	1
Canada	25	25	0.37	0.26	2
Portugal	10	10	0.60	0.60	2
The Netherlands	10	14	0.30	0.30	2
France	10	10	0.40	0.40	2
Germany	20	10	0.50	0.30	2
UK	10	10	0.60	0.45	2
Switzerland	13	17	0.25	0.20	2
Finland	8	8	0.28	0.22	3
Sweden	10	34	0.30	0.20	3

#### 2.1 Climate variations

Fourteen locations in North America and ten in Europe have been considered in this study. The 11 US climates include the six categorised previously for Annex 28 (IEA Subtask 1 report<sup>[3]</sup>), plus two additional locations in the Midwest, two in the West, and one on the West Coast. The two West climates (Denver and Albuquerque) have short dry summers for which evaporative cooling is particularly suited. The three Canadian climates (Halifax, Toronto and Edmonton) are cool, but with very different levels of bumidity. The European climates are all cool compared with US climates, but most are semihumid or humid, reducing the effectiveness for evaporative cooling. The general climate statistics for the 24 climates are shown in Table 2. The locations of the 24 cities are shown in Figure 2.

Table 2 Clim	ate statistics for selected Nor	th American and Eur	pean locations		
		Cooling	Enthalpy	Cooling	Enthalpy
		degree hours <sub>25</sub> *	hours <sub>25/40</sub> *	degree hours <sub>18</sub> *	hours <sub>18/40</sub> *
City	Climate description	(°C)	(kJ/(kg°C))	(°C)	(kJ/(kg°C))
North America	an locations		<u>.</u>		
Minneapolis	US 1 (warm/semi-humid)	2 540	21 341	13106	56 359
New York	US 2 (warm/semi-humid)	2 570	25698	15942	68 783
Washington	US 3 (hot/humid)	4 238	42 946	22142	93 286
Miami	US 4 (very hot/very humid)	11 896	144 969	59 420	254 614
Phoenix	US 5 (very hot/dry)	27 256	39 738	59 910	96 329
Los Angeles	US 6 (mild/semi-humid)	574	8 667	7 552	64019
Chicago	Warm and semi-humid	3 390	22140	16 366	60 552
Fort Worth	Hot and semi-humid	12176	75 416	39 240	141 860
Denver	Warm and dry	3 680	2086	14 392	24 426
Albuquerque	Warm and very dry	6136	8 603	22 892	38 049
San Francisco	Cool and semi-humid	194	3065	3 782	26 890
Halifax	Canada 5 (cool/humid)	122	3 806	2 266	26 432
Toronto	Canada 1 (cool/semi-humid)	1 042	15164	8 652	45 602
Edmonton	Canada 3 (cool/dry)	112	1 607	2 360	13372
European loca	tions				
Porto	Portugal 1	1 388	13080	10570	74 004
Lisbon	Portugal 1	1 936	12287	12122	64 204
Trappes	France 2	264	361	2 922	20 367
Carpentras	France 3	2136	9949	11 652	43 769
Nice	France 4	70	18175	9 046	64 789
Eelde	The Netherlands	148	1 829	2 464	22 811
Kew	United Kingdom	34	1 746	2 382	24 218
Zurich	Switzerland	346	3 786	4 244	26 968
Frankfurt	Germany	654	3 1 5 1	5 684	27 573
Helsinki	Finland	28	372	1 496	13547

\* For explanation of climate parameters, see p 64 of Subtask 1 report<sup>(3)</sup>



Figure 2 Representative North American and European climates studied

#### 2.2 System characteristics

#### 2.2.1 Stand-alone evaporative cooling systems

This analysis considered three types of stand-alone systems (direct, indirect, and indirect/direct) of four sizes providing 4, 8, 12 or 16 air changes per hour (ach) of evaporatively-cooled outdoor air. A schematic drawing of the evaporative cooling system configured in DOE-2 is shown in Figure 3. The effectiveness of a direct module is modelled as 0.85 at full-load conditions, while that of an indirect module is modelled as 0.60 at a wet-bulb temperature of 26.7 °C. Since the stand-alone units are assumed to have constant-volume fans, there is no change in effectiveness at part-load conditions, but the indirect effectiveness varies with the wet-bulb temperature based on the calculations using the Detailed Design Tool<sup>[4]</sup> (also see Figure 4).

To calculate the energy consumed by the evaporative cooling systems, the following modelling assumptions are used for fan static pressure and efficiency:

- direct systems 100 mm of water, 0.00025 kW/m<sup>3</sup>/hour
- indirect systems 100 mm of water, 0.00068 kW/m<sup>3</sup>/hour
- indirect/direct system 125 mm of water, 0.0010 kW/m<sup>3</sup>/hour



Figure 3 Stand-alone evaporative cooling systems

#### 2.2.2 Evaporative precooling systems

There are many situations where evaporative cooling cannot provide sufficient cooling to warrant use as a stand-alone system, but it can be used effectively to precool the supply air and reduce the need for mechanical cooling. Four evaporative precooling configurations are considered in this study: indirect with outdoor air as the secondary air, indirect with room exhaust air as the secondary air, and indirect/direct systems with the same two secondary air choices.

As with the stand-alone units, the effectiveness of the direct and indirect modules is assumed as 0.85 and 0.60 respectively. However, since the systems have variable-speed fans, their full-load effectiveness increases under part-load conditions as shown in Figure 4. Both the direct and indirect systems are assumed to increase the fan static pressure by 12 mm of water, while the indirect/direct system is assumed to increase it by 25 mm of water.

The mechanical cooling system is assumed to be a packaged variable-airvolume system identical to the conventional air-conditioning system described in the following section. No attempt has been made to downsize the mechanical system since under peak wet-bulb conditions, evaporative precooling potential is probably very small to nil. Figure 5 is a schematic drawing of a standard mechanical cooling system with evaporative precooling. The drawing shows outside air being used as the secondary air, but room exhaust air is also considered in the simulations.







Figure 5 Evaporative precooling systems

#### 2.2.3 Conventional air-conditioning system

The conventional air-conditioning system is modelled as a packaged variableair-volume system (PVAVS) similar to those typically installed in small- to medium-sized office buildings. The PVAVS is modelled using DOE-2 default values, ie a COP of 2.78, and a supply fan efficiency of 0.0012 kW/m<sup>3</sup>/hour. The DOE-2 program is also used to size the system automatically based on the building's cooling load. A schematic representation of the PVAVS is shown in Figure 6.

#### 2.3 System operation

The HVAC system is assumed to be operated with a typical office schedule that runs from 07.00 h to 18.00 h on work days, 08.00 to 14.00 h on Saturdays, and off on Sundays and holidays. When the system is on, heating is set to 21.1 °C and cooling to 25.8 °C. The stand-alone evaporative cooling system is also operated with the same schedule.

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Figure 6 Conventional packaged variable-air-volume system

#### 3 Design tables

The results from the DOE-2 simulations are shown in Tables 3 to 26 using a format similar to that developed by J R Millet in his parallel Annex 28 study on evaporative cooling in France<sup>[5]</sup>. Each table gives the results for one location. The 12 building conditions are shown across the top in order of increasing cooling loads from a building with low internal gains, low solar aperture, and high thermal inertia, to one with high internal gains, high solar aperture, and low thermal inertia. The sub-tables show (from top to hottom):

- 1 the peak indoor temperatures in the perimeter (per) and core (cor) zones in °C;
- 2 the percentage of annual hours where zone temperatures exceeded the thermostat setting (1% = 87.6 hours); and
- 3 the total electricity consumed by the fans and cooling system in kWh/m<sup>2</sup> of floor area.

The first sub-table indicates the performance of the evaporative cooling systems under design or peak conditions. The boxes are shaded dark, with white numbers, if the maximum zone temperatures exceed 34 °C, medium if they are between 30 °C and 34 °C, and light if they are between 26 °C and 30 °C. If the maximum zone temperature never reached 26 °C, the box is left white.

The second sub-table indicates the seasonal performance of the evaporative cooling systems by showing the number of hours when they are unable to maintain the thermostat settings. The boxes are shaded dark, with white numbers, if the total number of undercooled hours exceeds 10% or 876 hours, medium if it is between 5 and 10% (438–875 hours), and light if it is between 1% and 5% (88–438 hours). If the total number of undercooled hours is below 1% or 88 hours, the box is left white.

The third sub-table indicates the energy savings of the evaporative cooling systems relative to the reference PVAV system. The row showing total electricity consumed by the reference system is highlighted with light shading. The boxes showing the electricity consumed by the various evaporative cooling or evaporative precooling systems have medium shading if they exceed that of the reference cooling system, indicating energy penalties.

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	Location	1								Mi	nne	apo	olis	MN											
	internal gains	Ι			lo	w in	terna	l gai	ns								ł	1igh i	inter	nal g	ains				
	solar gains	<u> </u>	la	w			med	lium			hi	gh			lo	W			mec	lium			hi	gh	
	Inertia	hi	gh	lo	w	hi	gh	la	w	hi	gh	lo	w	hi	gh	lo	w.	hi	gh	ło	w	hi	gh	le	w
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	сог	рег	cor	per	cor	per	cor	per	cor	per	cor
Maximum	n Indoor Temperatures	(C)																							
	direct	29	27	30	27	<b>1</b> 32	27	30	28	31	28	33	28	32	30	32	30	34	31	33	31	33	31	3	31
8 ACH	indirect	<b>1</b> 30	28	31	28	32	28	31	29	31	29	34	29	32	81	33	31	34	31	33	32	34	32	ा	32
	dir/indir	28	26	29	26	31	26	29	27	30	27	32	27	31	29	31	29	33	29	31	30	32	30	34	30
	direct	28	27	29	27	30	27	29	27	29	27	31	27	30	29	31	29	32	29	31	30	31	30	33	30
12 ACH	indirect	29	28	30	28	31	28	30	28	30	28	32	29	31	30	32	30	33	30	32	31	32	31	34	31
	dir-indirect	27	26	28	26	29	26	- 28	26	28	26	30	26	29	28	30	28	31	28	30	28	30	28	32	28
	direct	28	27	29	27	30	27	29	28	29	28	31	28	30	29	30	29	31	29	30	29	31	29	32	29
16 ACH	indirect	29	28	30	28	<b>F</b> 31	28	30	29	30	29	32	29	31	30	31	30	32	30	32	31	32	31	33	31
	dir-Indirect	27	26	28	26	29	26	28	26	28	26	30	26	29	28	29	28	30	28	29	28	30	28	31	28
A/C only	PVAVS	25	26	25	26	25	25	24	25	24	25	24	25	26	26	26	26	25	26	25	26	25	25	24	25
Evan.	PVAVS + ind/OA	25	26	26	26	25	25	24	25	24	25	24	25	26	27	26	27	25	26	25	27	25	26	24	25
Pre-	PVAVS + ind/RA	25	25	25	25	25	25	24	25	24	25	24	24	25	26	26	26	25	26	24	26	24	25	24	25
Cooling	PVAVS + ind/dir/OA	25	26	25	26	25	25	24	25	24	25	24	25	26	27	26	27	25	26	25	26	24	26	24	25
••••	PVAVS + ind/dir/RA	25	25	25	25	25	25	24	25	24	25	24	24	26	26	26	26	25	26	24	26	24	25	24	25
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	direct	<del>  ;</del>	1			Ă			1			4				4	3	6	-	4	- 3	Å	3	5	
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	Location											Ne	wΥ	ork	NY										
	internal gains				1	low i	ntern	al ga	ins								hi	gh in	terna	al gai	ns				
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	Inertia	hi	gh	ic	w	hi	gh	lo	w	hi	gh	la	w	hì	gh	Ic	w	hi	gh -	le	₩	hi	gh	lo	*
ł.	bldg location	per	cor	per	cor	рег	cor	per	cor	per	cor	per	cor	per	сог	per	cor	per	cor	per	cor	per	cor	per	cor
Maximur	m Indoor Temperatures	∋ (C)														·									
	direct	29	28	30	28	₩32	28	∭30	29	\$31	29	33	29	₩32	31	32	#31	34	\$31	33	32	34	32	86	<b>9</b> 32
8 ACH	indirect	∭30	29	31	29	₩33	29	∦31	∭30	32	<b>₹30</b>	34	30	\$33	32	\$33	\$32	85	332	₩34	33	86	33	86	33
	dir/indir	29	27	29	27	\$31	27	∦30	28	30	28	32	28	∭31	30	32	\$30	833	\$30	32	31	\$33	31	85	31
	direct	29	28	29	28	30	28	29	28	30	28	32	28	₿30	(30	₿31	∭30	(32	₩30	<b>31</b>	30	\$32	\$30	33	#30
12 ACH	indirect	30	28	30	28	<b>31</b>	29	\$30	29	31	29	33	29	\$31	31	32	31	33	231	32	31	33	31	34	₿31
	dir-indirect	28	27	28	27	30	27	29	27	29	27	831	27	\$30	29	30	29	31	29	31	30	231	30	32	\$30
	direct	29	28	29	28	\$30	28	29	28	30	28	31	29	<b>X30</b>	30	31	30	832	30	₩31	30	¥31	∭30	33	\$30
16 ACH	indirect	30	29	30	29	131	29	<b>31</b>	30	31	30	32	30	31	31	32	₩31	33	₩31	32	31	\$32	\$31	\$34	\$31
	dir-indirect	28	27	28	27	30	27	29	28	29	28	₩30	28	30	29	30	29	31	29	#30	29	\$31	29	32	29
A/C	PVAVS	25	25	25	25	25	25	24	25	24	25	24	25	26	26	26	26	25	26	25	25	25	25	24	25
Evap.	PVAVS + ind/OA	25	26	25	26	25	26	25	25	24	25	24	25	27	28	27	28	25	27	26	27	25	27	24	25
Pre-	PVAVS + ind/RA	25	25	25	25	25	25	24	25	24	25	24	25	26	27	26	27	25	26	24	25	24	25	24	25
Cooling	PVAVS + ind/dir/QA	25	26	25	25	25	25	24	25	24	25	24	25	26	27	26	27	25	26	25	26	24	26	24	25
	PVAVS + ind/dir/RA	25	25	25	25	25	25	24	25	24	25	24	24	25	26	25	26	25	26	24	25	24	25	24	25
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Percent	hours undercooled																								_
	direct	5	3	6	3	<b>38</b> 8	3	<b>3</b> 105	3	<b>6</b>	3	<b>888</b>	4	<b>%10</b>	8	1	\$\$¥8	1 16	<b>3</b> 8	(W) 9	W 8	巍10	88 A	6	500 A
8 ACH	indirect	<b>3</b> 87	<b>3</b> 5	8		10	115	<b>3117</b>		8	5	10	1	12		្តិត	1	51	10	11	×10	10	<b>1</b> 0	36	<b>%</b> 10
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	direct	4	2	4	2	1	2	4	2	1115	2		2	<b>6</b>	1005	387	11115	AW 9	5	MW 7	M#5	<b>御影</b> 7	0006	\$1019	
12 ACH	indirect	5	4	8	4	7	4		4	6	4	8	4	8	1	<b>W</b> 9	17	10	7	8	<b>8</b> 87	9	麗7	\$10	8W 7
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	direct	3	2	3	2	1.5	2	3	2	4	2		2	<b>1</b>	4	<b>1</b>	4	7	4	)## 5	4	<b>新新</b> 5	4	<b>M</b> 6	4
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	dir-indirect	1	1	2	1	3	1	2	1	2	1	3	1	3	3	4	3	15	3	4	3	4	3	<b>1</b> 5	3
A/C	PVAVS	0	3	0	3	0	3	0	1	0	1	0	1	1	<b>187</b>	1	()()()	0	886	0	3	0	3		2
Evap.	PVAVS + ind/OA	0	3	0	3 (		3	0		0	1	0	Ō	2	<b>////6</b>	1	NW 6	0		0	3	0	2	0	1
Pre-	PVAVS + ind/RA	0	2	0	2	0	2	0	o	0	0	Ō	0	0	6	Ō		0	185		2	0		0	0
Cooling	PVAVS + ind/dir/QA	0.	2	0	2	0	2	0	0	0	0	0	0	1	5	1	<b># 5</b>	Ō	4	0	2	0	1	0	1
<sup>-</sup>	PVAVS + ind/dir/RA	0	2	0	2	0	1	0	0	0	0	0	0	0	5	0	5	Ō	4	Ō	1	0	1	0	0
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Cooling	and Fan Energy Use (k	Wh/n	n2)	<u>.</u>															_						
<u> </u>	direct	1	2	1	3	1	4	1	2	1	3	1	4	1	8	1	9	2	0	1	9	2	0	2	0
8 ACH	indirect	1	12 13 17 18		2	0	1	7	1	8	2	0	2	<u>~</u> 5	2	6	2	7		26	2	7	2	8	
	dir/indir	1	9	18		2	3	2	20	2	1	2	3	3	1	3	2	3	3	3	11	3	2	3	4
	direct	1	5	1	21 16		8	1	5	1	6	1	8	2	3	2	4	2	5	2	3	2	4	2	5
12 ACH	indirect	2	2	2	23		5	2	2	2	3	2	6	3	2	3	3	3	5	3	3	3	4	3	5
	dir-indirect	2	3	2	25		8	2	3	2	5	2	9	3	7	3	8	4	1	3	8	3	9	4	1
	direct	1	7	1	18		1	1	7	1	8	2	1	2	6	2	7	2	9	2	6	2	7	2	9
16 ACH	indirect	2	6	2	27		0	2	6	2	7	3	0	3	8	3	9		1	3		3	9		1
	dir-indirect	2	6	2	27 28		2	2	6	2	8	3	2	4	2	4	4	4	6		2	4	4	4	7
A/C	PVAVS	5	8	3	1	4	3	3	1		6	5	0	5	- 1	5	4	A A	5	-	5	5	9	7	2
Evap	PVAVS + ind/OA	2	7	3	31		2	1	1		5	A	8	5	O	5	4	- A	5	-	4		8	7	1
Pre-	PVAVS + ind/RA	- 2	7		1		2	3	1		4	4	8	5	<u>,</u>	5	3	- 0 A	4	-	3	5	7	7	늰
Cooling	PVAVS + ind/dir/OA	2	7	3	0		.1	1	0	1	3	<b>-</b> A	7	4	9	5	2	A A	3	4	2	5	6	- A	H
	PVAVS + ind/dir/RA		7	3	0		.1	3	0		4	4	8	4	9	5		R I	3		3	5	6	0 A	5
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	Location										٧	Vas	hin	gto	n D(	C									
<u> </u>	internal gains				1	ow ir	ntern	al ga	ins					Ť			hig	gh in	terna	I gai	ns				
	solar gains		lo	w			mec	lium			hi	gh			lo	w			mec	lium			hi	gh	
	Inertia	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	ě	hi	gh	lo	w	hi	gh	lo	w	hi	gh	la	w
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor
Maximun	n Indoor Temperatures	(C)																							
)	direct	₩31	₩30	₩32	<b>\$</b> 30	₹33	<b>2</b> 30	232	₿30	₹32	₹30	竇34	₩30	<b>§</b> 33	<b>ä</b> 32	至33	₹32	34	232	34	圓33	<b>3</b> 4	<b>8</b> 33	86	33
8 ACH	indirect	₹32	₩31	233	31	34	31	33	31	33	31	36	গ্র	34	<b>2</b> 33	34	33	35	33	35	34	88	34	( <u> </u>	34
]	dir/indir	30	29	831	29	32	29	31	29	31	29	33	29	32	蠹31	33	31	34	[3]	33	32	33	32	3£	32
	direct	\$31	蠹30	\$31	830	裏32	30	31	劉30	32	30	833	30	32	薹32	233	32	<b>∰</b> 33	32	33	<b>2</b> 32	\$33	圖32	<b>3</b> 4	32
12 ACH	indirect	\$32	831	32	31	<b>8</b> 33	81	32	<u>8</u> 31	33	31	34	31	33	<b>833</b>	33	33	234	33	34	33	34	33	35	33
1	dir-indirect	\$30	29	<b>Q</b> 30	29	31	29	30	29	31	29	32	29	31	31	32	31	33	31	32	31	32	81	33	31
	direct	31	讀30	層31	<b>2</b> 30	32	30	32	30	32	30	讀33	30	32	32	<b>§</b> 33	32	<b>\$</b> 33	32	33	32	33	32	34	32
16 ACH	indirect	32	31	32	231	33	31	33	831	33	31	34	31	33	\$33	34	33	X	33	34	233	834	33	33	33
	dir-indirect	230	29	慶31	29	31	29	31	29	31	29	32	29	31	831	32	31	戲32	31	32	<b>@</b> 31	\$32	31	33	31
A/C	PVAVS	25	26	25	26	25	26	24	25	24	25	24	25	25	26	25	26	25	26	25	25	24	25	24	25
Evap.	PVAVS + ind/OA	26	27	26	27	25	26	25	26	25	26	24	25	27	28	27	28	27	28	27	28	27	28	24	26
Pre-	PVAVS + Ind/RA	25	26	25	26	25	25	24	25	24	25	24	25	26	27	26	27	25	26	24	26	24	26	24	25
Cooling	PVAVS + ind/dir/OA	25	26	25	26	25	26	25	26	24	25	24	25	27	28	27	28	26	27	26	27	25	27	24	25
	PVAVS + ind/dir/RA	25	25	25	26	25	25	24	25	24	25	24	25	26	27	26	27	25	26	25	26	24	26	24	25
Percent I	hours undercooled												-												
	direct	8	6	<b>9</b> 9	6	00	6	8	6	<b>9</b>	6	୍ୱାର	6	12	00	12	10	14	00	1 20	<b>1</b> 0	1 DE	<b>E</b> 10	18	10
8 ACH	indirect	\$10	8	<b>i</b> 11	8	12	8	110	8	10	8	12	8	( R	12	٦K	12	্যন্ত	- 16	13	10	W.	(P	- 75	32
	dir/indir	() [] 7	5	<b>27</b> 7	5	<b>X</b> 10	5	6	5	8	5	9	5	10	9	90	9	92	9	<b>K</b> 10	9	- 60	9	12	9
	direct	(酒6	25	劉7	<b>1</b> 5	<b>1</b> 1 1 9	5	6	<b>1</b> 5	7.	國5	8	<b>1</b> 5	<b>1</b> 9	2018	<b>1</b> 0	8	. 90	8	9	8	飂9	8	10	8
12 ACH	indirect	8	8         7         9         7         10           5         3         5         3         7		7,	8	7	9	<b>187</b> 7.	10	7	00	10	30	10		10	10	10	90	10	12	10		
	dir-indirect	<b>1</b> 5	5         3         5         3         5         7           5         4         6         4         7		3	÷ [5	3	<u>,</u> 5	3	- 7	3	7	6	8	6	9	6	8	6	8	6	9	6		
	direct	纖5	5     3     5     3     7       5     4     6     4     7		4	1005	4	6	4	<b>88</b> 7,	4	飜7,	6	8	6	9	<u>%</u> 6	<b>207</b>	6	龖8	6	9	<b>8</b> 6		
16 ACH	indirect	(羅7)			6	7	6	8	6	9	6	<b>2</b> 9	8	<b>\$10</b>	18	00	8	9	8	置9	8	<b>\$10</b>	<b>28</b> 8		
	dir-indirect	4	4 3 4 3 <b>1</b> 6		3	4	3	4	3	6	3	6	驟5	6	5	7	5	6	<u> </u>	6	5	7	<b>2</b> 5		
A/C	PVAVS	0	4 3 4 3 16 0 115 0 115 0		4	0	1	0	1	0	1	1	<b>2</b> 10	1	<b>至</b> 10	0	8	0	4	0	3	0	2		
Evap.	PVAVS + ind/OA	1	躑5	1	建25	0	圜5	0	2	0	2	0	1	2	劉9	2	319	1	8	0	4	0	4	0	2
Pre-	PVAVS + ind/RA	0	3	0	4	0	3	0	1	0	0	0	0	0	8	0	8	0	6	0	2	0	2	0	0
Cooling	PVAVS + ind/dir/OA	0	4	0	4	0	4	0	1	0	1	0	0	1	8	1	8	0	6	0	3	0	3	0	1
	PVAVS + ind/dir/RA	0	3	0	3	0	3	0	0	0	0	0	0	0	<b>2</b> 27	0	- 7	0	5	0	2	0	1	0	0
	<u> </u>																								
Cooling	and Fan Energy Use (k	Wh/n	n2)																			<b>.</b>			
	direct	Ľ	20		21		2	<u> </u>	20	2	21	2	3	<u> </u>	28	1	29	3	0		29		9	3	10
8 ACH	indirect	<u> </u>	28	1	29		2	1	9	3	30	3	2	<u>⊢</u> ∶	39	4	11	4	2	4	10	4	1	4	2
	dir/indir	3	32		34	3	17		2	3	34	3	7	<u> </u>	17	4	18	5	50	4	17	4	9	5	i0
	direct		25	1	26	2	9	1	26	2	27	2	9		36	3	37	3	18	3	36		17	3	18
12 ACH	indirect	37 38		4	1		8	3	39	4	2		51		52		<u>i4</u>		51	-	53		<u>i4</u>		
	dir-indirect	÷. 4			4	6	6	0	4	12	4	6		58		50	e	52	<u> </u>	59	6	50	6	i3	
	direct		30 31		3	4		0	3	32	3	4	4	12	4	13	4	15	4	12	4	13	4	15	
16 ACH	indirect		45 46			<u>i0</u>		6		17	5	51	(	51	(	53	e	i5	<u> </u>	52	e	53	6	j5	
<u> </u>	dir-indirect	- C	45 46 46 48 48 48 48 48 48 48 48 48 48 48 48 48			4		17		50)	5	4		58 <u>,</u> =	27	(0)	7	'3		8	7	0	7	'3	
A/C	PVAVS		35		39	<u> </u>	2	:	8	4	13	6	0	6	53	6	57	7	'9	6	6	7	'1	8	\$7
Evap.	PVAVS + ind/OA	<b>88</b>	36		40)		3		19 🔤	4	13 🗃	5	9		54		i9)		1		7	7	2	<u> </u>	17
Pre-	PVAVS + ind/RA	L-i	35	<u> </u>	38	L:	51	<u> </u> :	37	4	12	5	8	Ľ	62	<b>_</b>	56	_7	8	<u> </u>	54	<u> </u>	i9	8	14
Cooling	PVAVS + ind/dir/OA	<u> </u>	35	ļ;	39	L :	52	<u> </u>	37	4	12	5	8		33		57	· 7	9	<u> </u> •	56	17	70	8	36
	PVAVS + ind/dir/RA	1	34	;	37	1 5	50		36	4	11	5	7	•	51	(	55	7	6	6	53	<u> </u>	58	٤ ا	13

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	Location											N	liar	ni F	L										
	internal gains				i	low ir	ntern	al ga	ins					Γ			hi	gh in	terna	al gai	ns				
	solar gains	· · · ·	ic	w			mea	lium		1	hi	gh		1	lo	w		Ť	me	dium			hi	ah	
	Inertia	hi	gh	lo	w	hi	gh	lo	w	hi	gh	10	w	hi	gh	lo	w	hi	gh	lo	w	hí	gh	10	w
	bldg location	per	cor	per	cor	per	cor	per	сог	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor
Maximun	n Indoor Temperatures	(C)									•	· · · ·					•								
	direct	29	28	30	28	32	28	30	29	831	29	33	29	₿32	31	33	\$32	34	32	833	32	34	32	86	32
8 ACH	indirect	\$30	29	31	29	\$33	29	31	30	32	30	34	30	33	32	33	32	35	33	34	33	86	33	- 816	33
	dir/indir	29	27	29	27	31	27	30	28	\$30	28	32	28	\$31	30	33	832	∦34	\$31	32	31	\$33	\$31	SE	31
	direct	29	28	29	28	\$30	28	29	28	\$30	28	32	28	∭30	30	32	#31	₩33	32	831	*30	32	830	\$33	830
12 ACH	indirect	30	28	30	28	\$31	29	30	29	31	29	33	29	31	31	32	32	34	33	32	31	33	31	34	31
	dir-indirect	28	27	28	27	30	27	29	27	29	27	31	27	\$30	29	32	\$31	33	31	<b>@</b> 31	₹30	\$31	830	32	30
	direct	31	<b>%30</b>	31	\$30	32	\$30	32	∭30	₿32	∭30	\$32	\$ 30	∦32	31	\$32	∰31	833	831	33	₩31	833	31	\$33	31
16 ACH	indirect	<u>\$</u> 31	231	32	831	32	∭31	32	31	32	₫31	33	31	32	32	33	\$32	33	32	<b>%</b> 33	32	33	32	34	32
	dir-indirect	<b>X</b> 31	30	31	30	32	30	\$31	30	\$32	30	\$32	30	\$32	31	₩32	∭31	≪33	\$31	\$32	₹31	\$33	31	33	ु 31
A/C only	PVAVS	25	25	25	25	25	25	24	25	24	25	24	25	26	26	26	27	25	26	25	25	25	25	24	25
Evap.	PVAVS + ind/OA	25	26	25	26	25	26	25	25	24	25	24	25	27	28	29	₹31	27	28	26	27	25	27	24	25
Pre-	PVAVS + ind/RA	25	25	25	25	25	25	24	25	24	25	24	25	26	27	27	28	25	26	24	25	24	25	24	25
Cooling	PVAVS + ind/dir/OA	25	26	25	25	25	25	24	25	24	25	24	25	26	27	27	29	26	27	25	26	24	26	24	25
	PVAVS + ind/dir/RA	25	25	25	25	25	25	24	25	24	25	24	24	25	26	27	28	25	26	24	25	24	25	24	25
Percent h	nours undercooled																		-		_				
	direct	229	2	0.31	25		25	23	25	[ SÍ	25	2	25	86	36	38	36	40	36	86	36	37	86	89	36
8 ACH	indirect	32	1	33	31         25         34         25           33         29         36         29           29         21         33         22           29         21         33         22           30         22         30         22           30         26         32         26           24         18         28         18           24         18         28         18		102	20	[E]	29	35	29	S.	<b>1</b> 39	89	839	41	39	87	38	36	38	60	38	
	dir/indir		21		21	25 34 25 2 29 36 29 1 21 38 22 22 30 22 7 26 32 26 57		27	20	29	21	000	21	Se	35	0)	35	100	185	\$6	82	130	80	\$ 33	- 34
	direct	25	82	26	22	1.80	22	25	121	27	24	29	21	81	29	32	29	3	29	- 90	29	32	29	<u>8</u>	29
12 ACH	indirect	28	2	F 30	1         25         24         25           3         75         36         75           9         21         30         22           6         22         30         22           6         22         30         22           6         22         30         22           6         22         30         22           6         22         30         22           6         22         30         22           6         20         32         126           4         20         18         20         18           4         20         26         20         1           7         22         30         22         2		: 29	PT:	्रश्त	26	89	26	87	33	35	183	86	38	িন্থন	8F	82	82	86	32	
	dir-indirect					122	18	20	19		18	27	18	20	27	Nº E	27	182		T CO	2	200	26	37	26
	direct	23	20		20	20	20	28	20		20	26	120	27	25	28	25	30	25	27	2	26	25	30	25
16 ACH	indirect	26	2	1.27	and		24	2.6	2	23	22	2	224	30	29	30	29	33	29	30	24	30	29	33	29
	dir-indirect				9.6		16		16		6	N.	16	25	22	26	22		.22	25	8	<b>N</b> /26	22	28	22
A/C	PVAVS	4	23	3	24	0	19	0	12	0	12	0	ΥŔ.	<b>7 1</b>	27	<b>5</b>	25	1	22	0	٩ř	0	<u> </u>	0	10
Evap.	PVAVS + ind/OA	<b>%10</b>	28	9	28	2	21	0	Ŷ	0	SP.	0	ΞĤ	<b>M</b>	<b>1</b> 29	12	28	4	25	1	- îł	0	- îe	0	§10
Рге-	PVAVS + ind/RA	4	20	2	20	0	17	0	<b>10</b>	0	<b>10</b>	0	10	6	25	4	25	0	21	0	10	0	9	0	. 8
Cooling	PVAVS + ind/dir/OA	6	<b>a</b> 72	4	<b>121</b>	0	19	0	<b>*1</b> ,1	0		0	10	<b>%10</b>	25	<b>#</b> 7	25	1		0	10	0	<b>%10</b>	0	8
	PVAVS + ind/dir/RA	3	<b>.</b> (1)	2	<u>_ (C</u>	0	16	_ 0	<b>%10</b>	0	<b>%10</b>	0	9	<b>\$\$</b> 5	23	4	22	0	15	0	<b>%</b> 9	0	8	0	<b>.</b>
·	·····	_																							
Cooling a	Ind Fan Energy Use (kV	Vh/m	2)													_		_							
ł	direct	5	3	5	4	5	6	5	2	5	3	5	5	6	2	6	2	6	4	6	1	6	2	63	3
8 ACH	indirect	7	2	7	4	7(	6	7	2	7	3	7:	5	82	2	8	3	8	5	8	1	8	3	84	4
	dir/indir	9	0 /////	9	2 📖	9	5 📖	<b>8</b>	9////	9	1311	9	4	10	)5	10	)7	10	)9	1(	)4	10	6	10	8
	direct	<b>36</b> 7	3 🛲	7	4	7	7	7	2	7	4	7(	6	8	5	6	7	8	8	8	5	8	6	87	7
12 ACH	indirect	1	11	10	3	10	6	10	01	<b>M</b> 10	)2	10	5	11	6	1'	17	11	19	11	15	11	6	11	8
	dir-indirect	12	23 🎊	<b>M</b> 12	26 🕅	13	0 🞆	<i>劉</i> 佩君:	23 🎆	<b>////1</b> 2	25	<u>12</u>	9	14	6	<b>3</b> 14	18	M#1:	51	繝14	15 💥	14	7.##	14	9
	direct	9	1000	9	3.88	9	6	9	1.000	<b>新版</b> 9	2 潮源	9	5	10	17	10	)8	11	10	10	)6	10	17	10	9
16 ACH	indirect	12	28 🛝		31	13	4 🕷	<b>***</b> 12	28 💹		30 🛝	13	4	14	7.22	14	18	1:	51		16 🗱	<b>M</b> 14	7.88	15	0
<u> </u>	dir-indirect	@#1t	53 🎆	###1:	56 <b>///</b>	16	2 淵源	<b>#</b> #1	52 讞	AW 1 2	55 🕅	<b>****</b> 16	1.8	AN 18	2.	811178	4	<b>388</b> 18	18 🞆	<b>311</b>	31	<b>#</b> 18	33	<b>\$\$\$</b> 18	7,200
A/C	PVAVS	7	0	7	6	94	4	7	7	8	4	10	4	11	8	12	25	14	14	12	26	13	3	15	3
Evap.	PVAVS + ind/OA	7	8 🛲	8	5 🕷	10	6 🕷	8 111	5 📖	9	2	<i>訓</i> [[11	4.00	13	4.00	MW 14	12 🕅	MK16	35 🕷	14	13 🎆	<b>劉昭15</b>	0.11	總郡17	1.000
Pre-	PVAVS + ind/RA	6	7	7	2	88	B	7	1	7	8	97	7	11	6	12	22	13	36	11	17	12	4	14	2
Cooling	PVAVS + ind/dir/OA	<i>@</i> <b>1</b>	8 🛲	<b>3111 8</b>	5,111	<b>10</b>	5.00	8	4	ØW 9	2	識[11	4 👹	<b>\$\$</b> 13	5 🎆	<b>1</b> 4	2	16	52 🐖	14	1	<b>31</b> 4	8	鐵17	0 🎆
L	PVAVS + ind/dir/RA	_ 6	9	7	5	9'	1	7	4	8	1	10	1	潮12	20 🎎	aiiii 1.	25 🗱	14	11	12	22	12	9	14	8

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	Location											Pł	loei	nix /	٩Z										
	internal gains					low ir	ntern	al qa	ins								hi	ah ini	terna	l gai	ns				
	solar gains		lo	w			med	- a- lium			hi	ah			lo	w			med	lium			hie	ah	
	Inertia	hi	ah	lo	¥	hi	ah	lc	w	hi	ah	j	w	hie	ah	lo	w	hi	gh	Ic	w	hie	ah	lo	w
	bidg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor
Maximun	n Indoor Temperatures	(C)				·		•				-				<u> </u>		-							
	direct	×32	\$30	32	\$30	<b>%34</b>	#30	\$32	\$30	33	\$30	96	\$30	33	32	<b>3</b> 4	32	िंद्रदे	32	34	\$32	35	32	36	32
8 ACH	indirect	33	\$32	\$ 34	32	SIG	32	34	\$32	86	332	37	32	ોંગ	34	36	34	35/	34	36	34	37	34	39	34
	dir/indir	\$30	28	\$30	28	\$32	28	30	28	831	28	33	28	31	\$30	32	30	33	30	32	\$30	32	30	34	30
	direct	₩31	29	<b>31</b>	29	\$32	29	×31	29	332	29	\$33	29	\$32	<b>%</b> 31	32	31	34	<b>%</b> 31	333	31	333	231	<b>3</b> 34	31
12 ACH	indirect	213	\$32	33	\$32	34	**32	233	332	34	\$32	36	32	34	433	34	33	25	33	95	333	গ্ৰন	33	17	33
	dir-indirect	29	27	29	27	₩30	27	29	27	29	27	Ø31	27	30	29	30	29	31	29	30	29	31	29	32	29
<u> </u>	direct	×31	30	831	30	322	30	¥ 31	30	\$32	30	233	30	32	<b>%</b> 31	32	31	33	<b>31</b>	32	31	33	31	34	31
16 ACH	indirect	33	32	33	32	80	32	34	32	34	32	26	32	34	33	30	33	SS	33	35	33	35	33	36	33
	dir-indirect	29	27	29	27	30	28	29	28	29	28	്30	28	30	29	30	29	31	29	30	29	30	29	31	29
AC only	PVAVS	26	27	26	27	25	26	25	26	24	26	24	25	26	28	26	28	25	27	25	26	25	26	24	26
Evan	PVAVS + ind/OA	26	27	26	27	25	26	24	26	24	26	24	25	26	29	26	28	25	27	25	27	24	27	24	26
Pre-	PVAVS + ind/RA	26	26	25	26	25	25	24	26	24	25	24	25	26	28	26	28	25	26	24	26	24	26	24	25
Cooling	PVAVS + ind/dir/OA	26	27	25	26	25	26	24	26	24	26	24	25	26	28	26	28	25	27	25	27	24	26	24	26
Cooling	PVAVS + ind/dir/RA	26	26	25	26	25	25	24	26	24	25	24	25	26	28	25	28	25	26	24	26	24	26	24	25
L				20	20																				
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	direct		809		10	66	80		385.9		40	600	07	600	100	- 20		200	- 10	600	700	67	6	00	
8 ACH	dializatia							1.12	2	100			1 10	1		- 60		200	- 32	37	200		- 20	- 70	- 67
		00					102005		8% o		2000		DRX o	00			00			00	¥. o		<u> </u>	<u></u>	3t0
12 404	direct	00	800		100				800 00	1	880		1.0	200	L V⊻ Taa		L 91	<u></u>	<u> </u>	00					a.a
12 ACH	dis indirect	EUA ENE +	2	100 C.D.	12	10	1 14	8000 8887	2 12	887 o	24	100		00		600	NR E	60	1944 s	00	200 F	00	800 s	41	2015
	dir-indirect	1 (in ite	Z	9/8% O	2 899	00	4	S16.0	∠ 1986-7	323 O	2		 5933.7				8992 O		25-8		650 O		2000 - 2016. 15 16 10		100
	direct	010		82.1U	202			289		010		- 4	64	1 22	629		200 B		838		100	07	00		50
16 ACH	dis indirect	1	1, 00,	1976 1976	1	97 o	1 20		1	200 G	8 U.S.	See 1	<u>1 1</u>	22.7	3	200 C	1 10	- 79	. 02	彩版7	3	87 g	- 29	- 77	3
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Pre-	PVAVS + Ind/RA		S101 9	- 4	1000	0	(1887) -		C ///20		316.0		4			2	2 V 2	- 0	×10		2005 O	L o	Sill E	0	
Cooling	PVAVS + ind/dir/DA	3	<u>89</u> 9	2	1007		382 J		88 J		-	0		1	- 66	2	34	- 0	00		200 F	0	200 A	0	~
	FYAY3 T IIIdidii/KA	-	120.00	9 2 1887		I V	Set.	L	<u> 28</u> 79	v		v		Ĵ		-	04	_			1987 -	v	MF /	v	~
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Cooling	and Fan Energy Use (Ki	WIUN	m2)				<u> </u>		<b>,</b>		r -		r –			•				4		•	4	E	
	direct		30		51		54		30		32		5			1	<u></u>				11 :0	4	3	4	2
8 ACH	indirect	43 45			50	-	4		40 40		-0		97 • 4		19	, r	2		38		6	0	~		
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	direct		38 40			14		38	<u> </u>	10	<u> </u>	14		2		14 16		)/ \a				4		~	
12 ACH	indirect		57 60			55		58	<u> </u>	51		20		4	<u> </u>	0		<u>su</u> 17		14		2		<u>v</u>	
	dir-indirect		55 58 45 48			5		55		8		>5	-	9		52		17		9		2	•	•	
	direct	4 1977 - 1	45 48			52		46	-	18		52		<u>.</u>		<u>, s</u>		<u>, 10</u>		<u>51</u>	6	3	0	0	
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Evap.	PVAVS + Ind/OA	┢╌┊	55		2		90		52		(U 20	+-}	U1		00	<del>ا ا</del>	74 VA		40	Ŀ	74 \\\\		v4	1	»∡ >o
Pre-	PVAVS + Ind/RA	L t	53	<u> </u>	<u></u>		57	<u> </u>	5U	┣-	80	1	19		2		<u>10</u>		18	╞──	<u>10</u>		00		10
Cooling	PVAVS + ind/dir/OA	ŀ	55 	<u> </u>	51 *0		58	1-1	00	<u> </u>	09	1	<i>91</i>		14 1.e		13	⊢┘	20	<u>⊢</u> }	2		1 1 1	1	20
	PVAVS + ind/dir/RA	L :	55		ΣC	1 8	59	1	61	L (	<b>6</b> 9	1 8	18	L <sup>E</sup>	5	l ;	14	1.1	<b>4</b> 4	؛ ر	13	1 1	UJ	1.	00

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	Location										L	.os	Ang	jele	s C.	A									
	internal gains				١	ow inte	erna	al ga	ins								hi	gh in	terna	ıl gair	าร				
	solar gains		lo	w		r	ned	lium			hi	gh			lo	w			mec	lium			hi	gh	
	Inertia	hi	gh	le	w	high	ר ו	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w
	bldg location	per	cor	per	cor	per c	ог	per	cor	per	сог	per	cor	per	cor	per	сог	per	cor	per	cor	per	cor	per	cor
Maximum	Indoor Temperatures	(C)																							
	direct	28	26	29	26	32	26	31	27	32	27	34	27	31	29	\$32	29	34	29	34	<b>%</b> 30	85	30	87	\$30
4 ACH	indirect	\$30	27	31	27	33	27	₩33	29	34	29	8 36	29	33	831	33	31	.85	31	86	33	87	33	89	33
	dir/indir	27	25	28	25	30	25	28	25	30	25	33	25	29	28	\$30	28	33	28	31	29	∛32	29	<b>8H</b>	29
	direct	27	25	27	25	29	25	28	26	29	26	\$31	26	29	27	29	27	31	27	830	28	31	28	\$33	28
8 ACH	indirect	29	27	30	27	32	27	31	28	32	29	34	29	31	\$30	832	30	\$33	830	33	831	\$34	31	<b>.</b> 66	31
	dir/indir	25	24	25	24	27	24	26	24	27	24	29	24	26	25	27	25	29	25	28	26	28	26	30	26
	direct	26	25	27	25	28	25	27	25	28	25	29	25	27	26	28	26	29	26	29	27	29	27	₩31	27
12 ACH	indirect	29	27	29	27	131	27	830	28	31	28	32	28	830	29	<b>%</b> 31	29	\$32	29	32	\$30	\$32	¥30	34	830
	dir-indirect	24	24	25	24	26	24	25	24	25	24	27	24	25	25	26	25	27	25	26	25	26	25	28	25
A/C only	PVAVS	24	25	25	25	25	25	24	24	24	24	24	24	25	26	25	26	25	26	25	25	24	25	24	25
Evap.	PVAVS + ind/OA	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	25	24	25	24	25	24	25
Pre-	PVAVS + ind/RA	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	25	24	25	24	25	24	24
Cooling	PVAVS + ind/dir/OA	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	25	24	25	24	25	24	24
	PVAVS + ind/dir/RA	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	25	24	24	24	24	24	24
L			·																						
Percent h	ours undercooled																								
- or or other	direct	3	2	80% G	2	<b>%10</b>	2	Å	2	20 A	2	\$10	2	67271	<b>1</b> 761	<u> </u>	-75	6	1 60	ាភា	10	- 373	777	and the	l ad
A ACH	indirect		2	······································			2		2	201 D	2	10					$\frac{1}{\alpha}$					6			L
	dir/indir	3000 2	1	A	1		1	3	1	1001 5					3810 3810		8819 8840		100	880.N 840	10 10 A	66	A 10		10
<b></b>	diract			4		2	-	4		30% J	- 0			4 1000	2		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	ST 7	2010		30.10	500 -	201	2000 0	10
8 ACH	indirect		0	2	0	3 10 5	0	2	0	2	0		0		3 8	1000	3 //////5	STR 0	5 100 E	4 2 100	3	199.5	3	10 M	
	dir/indir	'n	0	<u>^</u>		2	-		0	1	0	3000	0	2 2 2 2	2	3	7000 D	388 9 388 9	1008.0	3000 3		3/00/ C	4	NIV C	-4
	dimindii diment						~	0	0	<u>'</u>	0	3	-				2	3112 O	4	3	2	4	2	<i>}}%</i>	<u> </u>
12 401	urect Indianat	- U	0	0			-	U 4	- 0	0	U 0		0	1	0		0	3 888 E	0	1	- 0	2		4	
	mairect dis indisent	0	0		0	4	~	1			0	3			2	3	2	356 D	2	3	2	3	2		2
AIC	dir-indirect	0	0 0 1		0	-	-	0			0	1	0	0	10 1010 e	-	0	2	0	0	0	1	U	3	
A/C	PVAV3	0	0	0	0	0	-	0	0	0	U		0	0	()))) C ())) C ()) C ()) C () C () C ()	0			4	0	0	0	U	0	0
evap.	PVAVS + ind/UA	U U	0	0			-			0		0	0	0	4	0	4	0	2	0	0	0	0	0	
Cooling	PVAVS + IND/KA			- 0			0	0		0	<u> </u>	U	0	0	4	0	4	0	2	0	- 0	0	0	0	
Cooling	PVAVS + ind/dir/UA	0		0			-		0	0	0	0	0	0	2	0		0		0	0	0	0	0	
	PVAVS + Ind/di//RA	U	0	0	U	U	U	U	U	U	U	U	U	Ŭ	3	Ų	3	v		0	U		U	U	
C + +!!		1-1	2)																						
Cooling a	Ind Fan Energy Use (Ke	Vh/m2)			_								_		•						•				
1	direct		5	- 1	0	11	-			1	0	1	1	1	8	1	9	1	9	1	8	1	9	1	9
4 ACH	indirect	1	2	1	4	16		1	3	1	5	- 1	6 	2	5	2	0	2	7	2	5	2	6 2	2	<u></u>
	aiminair		4		0	19		1	4		0	1	9	3		3	2	3	3	3	U	3	2	3	3
		10 12		4	14		1	1	1	2	1	5	2	3	2	<u> </u>	2	6	2	3	2	5	2	6	
8 ACH	Indirect	16 18		8	22		1	-	1	9	2	2	3	4	3	6	3	8	3	4	3	6	3	8	
	aiminair	1	16 19 11 13		9	23	_	1	1	2	U		4			4	0	4	د		8	4	U	4	3
	direct	1	11 13 18 20		3	16	-	1	2	1	4	1	7	2	5	2	7	2	9	2	6	2	7	3	<u>0</u>
12 ACH	indirect	1	18 20 17 20		25	_	1	9	2	1	2	6	3	8	4	1	4	4	3	9	4	1	4	4	
	dir-indirect	1	17 20 29 33		20	25		1	8	2	1	2	6	4	0	4	4	4	7	4	1	4	4	4	8
A/C	PVAVS	2	29 33		13	47		3	6	4	1	5	8	5	4	5	9	7	1	6	1	6	6	8	3
Evap.	PVAS + ind/OA	2	9	3	3	46		3	6	4	1	<b>111</b> 5	8 🕷		4	<b>3</b> 5	9 🎆	<b>*</b> 7	128	6	1	6	6	8	3
Pre-	PVAS + ind/RA	3	0	MW3	4300	49		3	8	4	3 🕅	6	1.000	/////5	7.40	6	2 瀟蘆	287	5	<b>6</b>	4	6	930	8	7
Cooling	PVAS + ind-dir/OA	2	7	3	1	44		3	4	3	9	5	5	5	1	5	6	6	7	5	7	6	2	7	8
L	PVAS + ind-dir/RA	2	9 🞆	MW 3	3瓢	47	399	繝 3	6 🕷	4	2 🗱	<b>飘滚</b> 5	9 💥	<b>制服</b> 5	5 🌋	6	0.000	2247	2	6	2團影	6	7	8	4

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	Location											Ċ	nica	igo	IL_										
	internal gains				1	ow ir	nterna	al ga	ins								hi	gh int	lerna	l gair	าร				
	solar gains		lo	w			med	ium			hig	gh			lo	W			med	lium			hi	gh	
	Inertia	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	¥	hig	gh	lo	w	hi	gh	lo	W
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor
Maximur	n Indoor Temperatures	(C)																							
	direct	29	27	29	27	31	27	30	28	: 30	28	\$33	28	31	30	32	30	33	30	32	31	33	31	35	31
8 ACH	indirect	30	28	30	28	32	28	31	29	32	29	34	29	32	31	33	31	34	31	33	32	34	32	83	32
	dir/indir	28	26	28	26	30	26	29	27	29	27	31	27	30	29	្ល31	29	32	29	31	് 30	32	30	34	30
	direct	28	27	29	27	30	27	29	27	29	27	\$31	27	30	29	30	29	32	29	31	\$30	∛31	ं 30	33	30
12 ACH	indirect	29	28	30	28	31	28	30	28	31	29	32	29	31	30	31	30	33	30	32	31	32	31	34	31
1	dir-indirect	27	26	28	26	29	26	28	26	28	26	30	26	29	28	29	28	. 31	28	30	29	30	29	231	29
<u>}</u>	direct	28	27	29	27	×30	27	29	28	29	28	31	28	30	29	30	29	31	29	30	29	31	29	32	29
16 ACH	indirect	29	28	30	28	31	28	30	29	30	29	32	29	31	30	31	30	32	30	31	31	32	31	33	31
	dir-indirect	27	26	28	26	29	27	28	27	28	27	30	27	29	28	29	28	30	28	29	28	30	28	<b>31</b>	28
A/C	PVAVS	25	26	25	26	25	26	25	25	24	25	24	25	26	27	26	26	25	26	25	26	25	26	24	25
Evan.	PVAVS + ind/OA	25	26	25	26	25	26	24	25	24	25	24	25	26	27	26	27	25	27	25	27	25	26	24	25
Pre-	PVAVS + ind/RA	25	26	25	26	25	25	24	25	24	25	24	25	25	26	25	26	25	26	24	26	24	25	24	25
Cooling	PVAVS + ind/dir/OA	25	26	25	26	25	26	24	25	24	25	24	25	26	27	26	27	25	26	25	26	24	26	24	25
	PVAVS + ind/dir/RA	25	26	25	26	25	25	24	25	24	25	24	25	25	27	25	26	25	26	24	26	24	25	24	25
					•						<u></u>			·											·
Percent	hours undercooled																				·				
	direct	5	3	7	3	ેં્વ	3	ି <sup>1</sup> 5	3		3	9	3	<u></u>	9	ିଶଗ	<u></u> 9	18	9	10	8 : 9	ିଶ୍ୱ	9	10	្ទ
8 ACH	lindirect	7	िड	8	5	6	865	7	5	8	5	10	5	12	00	íß	l an	Tre l	00	12	10	10	10	10	0
	dir/indir	3	1	4	1	7	1	3	1	5	1	7	1	8	6	9	6	00	6	8	6	9	6	06	6
	direct	3	2	4	2	6	2	3	2	4	2	6	2	7	5	7	5	9	5	7	§ 5	7	5	<b>%</b> 9	5
12 ACH	indirect	5	3	4 2 3 6 3 3 2 0			4	5	3	6	4	8	4	9	7	9	7	00	7	8	7	9	7	10	7
	dir-indirect	2		2	0	4	Ó	2	0	2	0	4	0	4	3	5	3	7	3	4	3	5	3	7	3
	direct	2						2				80 ° F	1	1994 -	<u> </u>	A I		7		ंड	4	<sup>195</sup> 5	4	7	4
	indicact	4		ंह	<u> </u>	6	<u> </u>			<u> </u>		6	3	7	6	7	6	9	6	7	6	7	6	8	6
IN ACT	dir-indirect	1		1	- o	3	ő	1		1	- o	3	0	3	2	3	2	5	2	3	2	3	2	2.5	2
AIC	BVAVS	, o	80 G	0	S	0		0	2	, O			2	2	9	2	9	0	8	0	5	0	4	0	2
Even	DVAVS + ind/OA	ŏ	800 S		500 S	<u> </u>	CH.C.	-		- o	2	0	1	2	8	2	6	0	7	0	4		3	0	2
Evap. Bro	PVAVS + ind/BA	0	Million -		200 S		2007 <b>3</b>			- ů	2		1		878	1	8	, o	7		3	- o	2	0	
Cooling	PVAVS + ind/dir/OA	- ů	805		140			۲,		۰ ۱		<del>ا أ</del>	1		7	1	7		6		3	0	2	0	
Cooling	PVAVS + ind/dir/BA	a	4		885	Ō	4	Ō		ō	1	Ō	1	1	7	1	87	0	6		3	0	2	0	
	PTATO / Indianita	Ů	1 -		1587.0			_ •	· ·		<u> </u>	<u> </u>			100.000			,							<u> </u>
Cooling	and Ean Energy Lise /k	Wh/n	n21												_								_		
ocomig	direct	4	12		13		15		12		13	1	5		18	1	19	7	20	1	9		19	:	20
R ACH	indirect		<u>, -</u> 17	┢	18		20		18		19		21		25		26		27		5		26		27
	dir/indir		19		21		24		19		21		24		30		31		3		1		32		34
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12 404	indirect	<u> </u>	22		23		26		22		24		26	┢╴╡	32		33		4		2		33		35
12 401	dir-indirect		22 23		1	28		23		25		 29		37		38						39		41	
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	PVAVS	+	20		30	<b>↓</b> _'	+3		د¢۲ ۵0		74 20	<u>⊢</u> "	+5 17	<b>⊢</b> '	41	+	51	┝	-** : 1	+	10		50		
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	Location											For	t W	orti	י T)										
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	bldg location	per	cor	per	cor	per	cor	per	cor	per	сог	per	cor	per	cor	per	cor	per	lcor	per	cor	per	cor	per	Cor
Maximu	m Indoor Temperatures	; (C)		•												<u>.</u>			<u> </u>						
	direct	31	30	32	\$30	233	30	32	30	32	30	\$34	30	33	\$32	33	\$ 32	85	32	34	\$32	34	32	হার	32
8 ACH	indirect	33	31	33	31	136	31	33	31	34	831	36	31	34	33	105	33	100	33	<b>33</b>	134	<b>NO</b> A	\$ 34		34
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12 ACH	indirect	32	31	33	31	34	31	33	31	33	31	35	31	34	\$33	34	833	105	33	\$ 34	333	No.	833		33
	dir-indirect	30	29	30	29	31	29	30	29	30	29	32	29	31	831	32	31	\$32	31	32	31	32	31	33	31
	direct	31	30	831	30	32	30	\$31	30	32	30	\$33	30	32	<b>%</b> 31	32	<b>Ø</b> 31	33	31	32	31	×	31	34	21
16 ACH	indirect	33	31	33	31	34	31	33	32	33	32	335	32	34	33	34	33	85	33	84	33	95	33	33	13
	dir-indirect	30	29	31	29	31	29	30	30	31	30	32	30	32	\$31	32	31	32	31	\$32	32	32	32	33	₩32
A/C	PVAVS	26	27	26	27	25	27	25	26	24	26	24	26	27	28	26	28	25	26	25	26	25	26	24	25
Evap.	PVAVS + ind/OA	27	28	27	28	25	27	26	27	25	27	24	26	29	\$30	28	\$30	28	30	28	30	28	<u></u> 30	24	26
Pre-	PVAVS + ind/RA	26	27	26	27	25	26	25	26	24	26	24	26	26	27	26	27	25	26	24	26	24	26	24	25
Cooling	PVAVS + ind/dir/QA	26	28	26	28	25	27	25	27	24	26	24	26	29	30	29	30	26	28	28	30	26	28	24	26
ł	PVAVS + ind/dir/RA	26	27	26	27	25	26	25	26	24	26	24	26	27	29	26	28	25	26	25	27	24	26	24	25
Percent	hours undercooled						_		-		-			_						-					
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8 ACH	indirect	17	16		15	20	15	1.57	. 33	1	1	20	15	20	19	2	19	28	19	2	ីតី	26	10	22	19
	dir/indir	1.4	11	193	111	17		314		16	11	17	Rai	12.92	16		<b>8</b> 76	50				56	18	20	1
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12 ACH	indirect	15	30	40	N.	1	414	15	20	10	Ŷ	147	40	1	67	T	<b>(</b> 77)	10	- 67	75	177	<b>โ</b> กลี	77	60	
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	direct	a and a second		WE TO				173			11	177	-11		14	M C	14	313	14	415	32		70	-	- 7
16 ACH	indirect	14			13	L G	13	1	10	15		16	10	G	15	133	<b>1</b> 15	1	6	16	1	10	វភ	17	16
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Evap.	PVAVS + ind/OA	4		3		0	10	0	<b>7</b>	0	<b>6</b>	0	<b>5</b>	6	35	<b>1</b>	16	0	( 'K)	0	111119	0	7	0	4
Pre-	PVAVS + ind/RA	2	- Fi	1	<b>SA</b>	0	8	0	6	0	6	0	5	3	13	2	12	0	9	0	5	0	5	ō	3
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	direct	2	9	3	0	3	3	3	0	3	1	3	3	3	9	4	0	4	1	3	9	4	0	4	1
8 ACH	indirect	4	1	4	3	4	5	4	2	4	4	4	7	5	4	5	5	5	7	5	4	5	6	5	7
	dir/indir	5	0.11	5	2	5	5	5	1	5	3	5	6	6	5	6	7	6	9	6	6	6	B	7(	0
	direct	4	0	4	2	4	4	4	1	4	2	4	5	5	1	5	2	5	4	5	1	5	2	54	4
12 ACH	indirect	5	6.	5	8	6	1	MW 5	8	5	9.111	6	3	7	1	7.	3	7	5	7	2	74	4	7(	6
	dir-indirect	6	8	<b>886</b> 7	0)))))))	7	4	<b>8 6</b>	8	1	0 🛲	7:	5	8	6 🎆	8	8	9	1	8	7	81	3	9	1
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A/C	PVAVS	4	9	5	4	7	5	5	3	5	9	8	5	8	4	8	9	11	11	81	8	9	5	12	0
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	Location											De	env	eru	.0						_				
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{	solar gains		la	w			med	ium			hi	gh			Jo	w		Ì	med	lium			hi	gh	
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	bidg location	рег	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	çor	per	cor	per	cor	per	cor
Maximur	n Indoor Temperatures	(C)																							
	direct	27	24	28	24	₹30	24	27	25	28	25	蹇32	25	29	28	\$30	28	\$32	28	鬣30	28	231	28	34	28
4 ACH	indirect	29	26	30	26	\$32	26	29	27	<b>#30</b>	27	<b>3</b> 33	27	₩31	豪30	32	30	\$34	\$30	32	30	33	\$30	36	30
ļ	dir/indir	25	24	26	24	29	24	26	24	27	24	<b>\$</b> 30	24	28	27	29	27	31	27	28	27	∭30	27	<u>3</u> 32	27
	direct	25	24	25	24	27	24	25	24	26	24	28	24	26	25	27	25	29	25	27	25	27	25	29	25
8 ACH	indirect	27	25	28	25	29	25	27	25	28	25	130	25	29	28	29	28	\$31	28	29	28	\$30	28	\$32	28
	dir/indir	24	23	24	23	26	23	24	23	24	23	26	23	25	24	25	24	27	24	25	24	26	24	28	24
	direct	24	23	25	23	26	23	24	23	25	23	26	23	25	24	25	24	27	24	25	24	26	24	27	24
12 ACH	indirect	26	25	27	25	28	25	26	25	27	25	29	25	28	26	28	26	29	27	28	27	28	27	\$30	27
1	dir-indirect	23	23	24	23	24	23	24	23	24	23	25	23	24	24	24	24	25	24	24	24	24	24	26	24
AC only	PVAVS	25	25	25	25	25	25	24	25	24	24	24	24	26	27	26	26	25	26	24	25	24	25	24	25
Evap.	PVAVS + ind/OA	25	25	25	25	24	25	24	24	24	24	24	24	25	26	25	26	24	25	24	25	24	25	24	24
Pre-	PVAVS + ind/RA	25	25	25	25	24	25	24	24	24	24	24	24	25	26	25	26	24	25	24	25	24	25	24	24
Cooling	PVAVS + ind/dir/OA	24	25	25	25	24	24	24	24	24	24	24	24	25	25	25	25	24	25	24	24	24	24	24	24
	PVAVS + ind/dir/RA	24	25	25	25	24	25	24	24	24	24	24	24	25	25	25	25	24	25	24	24	24	24	24	24
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4 ACH	indirect	<b>%</b> 5	2	্ৰ7	2	\$10	2	1	2	<b>8</b> 7	2	10	2	10	10	12	\$10	16	10	\$10	\$10	12	<b>K</b> 10	16	\$10
	dir/indir	1	0	2	0	<b>6</b>	0	1	0	3	0	6	0	<b>1</b> 15	4	<b>*</b> 7	4	<b>X10</b>	4	6	4	888	4	<b>10</b>	4
	direct	0	0	1	0	2	0	0	0	1	0	3	0	2	1	3	1	¥.5	1	2	1	3	1	<b>5</b>	1
в асн	indirect	2		3		5	0	2	0	3	Ť	25	0	115	3	6	3	8	3	<b>*</b> 5	3	<b>6</b>	3	8	3
	dir/indir	- 0	0	0		1	0	0	0	0	0	1	0	0	Ō	1	0	2	0	0		1	0	3	0
	direct	ō	0	0	0	1	0	0	0	0	ō	1	0		Ö	1	0	2	0	0	0	1	0	2	0
12 ACH	indirect	Ť	0	1	0	3	0	1	0	2		3	0	3	1	3	1	5	1	3	1	3	1	<b>题</b> 5	1
	dir-indirect	o	0	0	0	Ō	0	0	0	0	Ō	0	0	Ō	0	0	0	0	0	0	0	0	0	0	0
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Evap.	PVAVS + ind/OA	0	1	0	1	ō	0	0	0	0	l o	0	0	0	4	0	4	0	2	0	- 0	0	0	0	0
Pre-	PVAVS + ind/RA	Ō	1	0	1	Ö	0	0	0	0	0	0	0	0	4	0	4	0	2	0	0	0	0	0	0
Cooling	PVAVS + ind/dir/OA	O	0	0	0	0	0	0	0	0	0	O	0	0	2	0	2	0	1	0	0	0	0	0	0
"	PVAVS + ind/dir/RA	Ō	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	1	0	0	0	0	0	0
<u> </u>	l	L																				<u></u>			
Cooling	and Fan Energy Use (k	Wh/m	12)																						
<u> </u>	direct	Ē	6		7		•		7		8		•	1	2	1	3	1	4	1	3	1	4	1	5
4 ACH	indirect		1	1	2		3	1	1	1	2	1	4		8	1	9	2	0	1	9	2	0	2	1
]	dirlindir		9	1	15		3	1	0	1	1	1	4		9	2	- !1	2	2	2	0	2	2	2	3
	direct		7		9		1		-		<u>`</u>	1	2		5		7		8	1	6	1	-	1	<u> </u>
8 ACH	indirect	<u> </u>	4	1	6		<u>.</u>	1	5	1	7	1	9		6		7		<u>, a</u>		6	2	8	3	0
	dir/indir	1	0	16 12			6	1	1	1	3	1	7		2		5	2	7		3	2	5	2	8
	direct		R	9		-	2		R	- 1	0	1	3		6	1	8	2	20		7	1	8	- 2	1
12 ACH	indirect		8 <u>9</u> 16 18			2	1	7		9	- 2	1		10		2		4		1	3	2		5	
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AIC	PVAVS	2	3	2	.7		1	2	7	3	2	<u> </u>	1		2		7				7	<u> </u>	2	7	<u> </u>
Evan	PVAVS + Ind/OA		9	-	2			2	2	,	6		3		4	<u> </u>	7		8		,		,	5	8
Pre-	PVAVS + ind/RA	5			24		7	2	4	5	9	4	7				., .0		3		1		 6	с А	<u> </u>
Cooling	PVAVS + ind/dir/OA	1	7		20	3	1	2	20	2	4	3	9		 1		4		4	3	5	3		5	2
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	Location										Α	lbu	que	rqu	e N	M									
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	solar gains		j i	w		I	me	dium			hi	ah			ł	w	_	Ī	me	dium			hi	nh	
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	bldg location	per	cor	per	cor	per	cor	рег	cor	per	cor	per	cor	per	cor	Der	cor	per	cor	Der	cor	per	COL	Der	Cor
Maximu	m Indoor Temperatures	(C)	•		-					<u> </u>			_						1++-			<b>F</b> 4.		<b>P</b> 01	
	direct	29	26	\$30	26	₿32	26	30	26	\$31	26	34	26	\$32	<b>Ø</b> 30	\$32	\$30	\$34	30	\$33	¥30	233	\$30	ିର୍ବ	<b>⊗</b> 3∩
4 ACH	indirect	31	29	32	29	34	29	32	29	33	29	836	29	34	\$32	34	\$32	<u>ê</u> s	32	103	\$33	36	833	20	233
	dir/indir	27	25	28	25	\$31	25	28	25	29	25	32	25	\$30	28	831	28	833	28	831	29	32	29	34	29
	direct	27	25	27	25	29	25	27	25	28	25	<b>30</b>	25	29	27	29	27	831	27	29	27	₩30	27	32	27
8 ACH	indirect	30	27	30	27	32	27	30	28	31	28	33	28	31	830	32	30	33	30	32	30	32	30	34	30
1	dir/indir	25	24	26	24	27	24	25	24	26	24	28	24	27	25	27	25	29	25	27	25	28	25	29	25
	direct	26	24	26	24	28	24	26	24	26	24	28	24	27	26	27	26	29	26	27	26	28	26	29	26
12 ACH	indirect	29	27	29	27	∭31	27	29	27	30	27	31	27	30	29	31	29	32	29	30	29	831	29	32	29
	dir-indirect	24	24	25	24	26	24	24	24	25	24	26	24	25	25	26	25	27	25	25	25	26	25	27	25
A/C	PVAVS	26	26	26	26	25	26	24	25	24	25	24	25	26	27	26	26	25	26	25	26	24	25	24	25
Evap.	PVAVS + ind/OA	25	26	25	26	25	25	24	25	24	25	24	25	25	26	25	26	25	25	24	25	24	25	24	25
Pre-	PVAVS + ind/RA	25	26	25	26	25	25	24	25	24	25	24	25	25	26	25	26	25	25	24	25	24	25	24	23
Cooling	PVAVS + ind/dir/OA	25	26	25	26	24	25	24	25	24	25	24	24	25	26	25	26	24	25	24	25	24	25	24	24
[	PVAVS + ind/dir/RA	25	26	25	26	24	25	24	25	24	25	24	24	25	26	25	26	24	25	24	25	24	25	24	24
-																		<u> </u>	1						
Percent	hours undercooled																-				-				
	direct	5	2	<b>1117</b>	2		2	6	2	17	2	12	2	<b>677</b> 73	9		9		#K 9		<b>8</b>		888	6	8
4 ACH	indirect	8	5	10	5	30	5	8		×10	5	- 64	5	E	13	16	13	18	13	1	1P	<b>T</b>	12	10	10
	dir/indir	3	0	5	0	9	0	3	0	5	0	10	0	8	6	Xi	6	1	MK 5	<b>%</b> 9	5		35	12	5
	direct	: 1	0	2	0	5	0	1	0	2	0	5	0	4	2	105	2		2	4	2		2	7	2
8 ACH	indirect	<b>15</b>	2	6	2		2	5	2	6	2	8	2	8	6	9 10	6	G	6	<b>**</b> 7	6	8	<b>6</b>	กัก	6
	dir/indir	0	Ő	0	0 2		0	0	0	0	0	3	0	2	0	2	0	5	0	2	0	2	0		0
	direct	0	0	1	02		0	Ō	0	1	0	2	0	2	0	2	0	4	0	2	0	2		4	0
12 ACH	indirect	3	1	4	0 2		1	3	1	4	1	5	1	<b>5</b>	4	B	4	7	4	5	3	6	3	667	3
	dir-indirect	0	0	0	4 1 (M) 0 0		Ö	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
A/C	PVAVS	1	6	1			4	0	1	0	1	0	0	1	9	1	<b>9</b>	0	<b>107</b>	0	3	0	3	0	1
Evap.	PVAVS + ind/OA	0	4	0	4	0	2	0	0	0	0	0	0	1	6	1	6	0	4	0	1	0	-1	0	0
Pre-	PVAVS + ind/RA	0	4	0	4	0	2	0	0	0	0	0	0	1	1	0	6	0	4	0	1	0	1	0	0
Cooling	PVAVS + ind/dir/OA	0	3	0	3	0	2	0	0	0	0	0	0	0	5	0	4	0	2	0	Ō	0	히	0	0
	PVAVS + ind/dir/RA	0	3	0	3	0	2	0	0	0	0	0	0	0	5	0	5	0	2	0	0	0		0	0
							-																<u> </u>		
Cooling	and Fan Energy Use (kV	Nh/m	/m2)																						
	direct	Ş	2	1	0	1	1	g	)	10	0	12	2	1	5	1	6	1	7	1	5	10	5	1	7
4 ACH	indirect	1	4	1	6	_1	8	1	5	1(	6	18	3	2	2	2	4	2	5	2	3	24	4	2	5
	dir/indir	1	3	1	5	1	8	1	4	1	5	18	3	2	4	2	6	2	7	2	5	20	5	21	8
	direct	1	1	1	2	1	5	1	1	1:	2	1!	5	20	0	2	1	2	3	2	0	2	i	2:	3
8 ACH	indirect	2	1	22		2	5	2	1	2:	3	26	3	3:	2	3	4	3	6	3	3	34	4	3(	6
	dir/indir	1	5	17		2	2	1	6	18	B	23	3	29	9	3	2	3	5	3	0	32	2	3:	5
	direct	1:	2	13		1	7	1	2	14	4	17	7	2	2	2	3	2	6	2	2	23	3	. 20	6
12 ACH	indirect	2	5	2	13 27		1	2	5	27	7	31		3	9	4	1	. 4	4	3	9	4	ιT	44	4
	dir-indirect	1	6	27 18		2	4	10	6	19	9	24	1	3	1 [	3-	4	3	8	3	1	34		38	3
A/C	PVAVS	3	0	3	5	5	1	3	4	39	9	61	I	5	4	5	9	7	6	5	8	64	1	8(	ô
Evap.	PVAVS + ind/OA	2	4	2	8	4	2	2	7	32	2	51		4	3	4	7	6	1	4	6	51	i t	7(	5
Pre-	PVAVS + ind/RA	2	6	3	0	4	5	3	0	3	5	56	3	4	6	5	0	6	5	5	0	_ 5!	;	7:	5
Cooling	PVAVS + ind/dir/OA	2	2	2	5	3	8	2	5	29	9	46	5	39	9	4	3	5	5	4	2	46	;	62	2
	PVAVS + ind/dir/RA	2	3	2	7	4	0	2	6	31	1	49	)	4	2	4	6	5	9	4	5	50		66	3

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	Location										Sa		ran	CISC	:0 U	A_					_				
	internal gains				I	ow in	terna	ıl gai	ns								hig	ıh int	erna	l gair	15				
	solar gains		lo	w			medi	ium			hiç	gh			lo	w			med	ium			hiç	ţh	
	Inertia	hig	jh	lo	w	hiç	ıh	lo	w	hig	an	lo	w	hig	gh	lo	w	hiç	jh j	lo	w	hig	ih	lo	w _
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor
Maximun	n Indoor Temperatures	(C)																							
	direct	26	25	27	25	30	25	28	25	29	25	32	25	29	28	<b>30</b>	28	32	28	31	29	/32	29	34	29
4 ACH	indirect	27	26	28	26	31	26	29	27	31	27	33	27	- 30	29	-31	29	33	29	32	31	34	31	36	31
	dir/indir	25	24	26	24	28	24	26	24	27	24	30	24	27	26	28	26	31	26	29	27	30	27	33	27
	direct	25	24	26	24	28	24	26	24	27	24	29	24	27	26	27	26	29	26	28	26	29	26	31	26
8 ACH	indirect	27	25	27	25	29	25	_28	26	29	26	31	26	28	28	29	28	31	28	30	29	31	29	32	29
	dir/indir	24	23	24	23	26	23	24	23	25	23	27	23	25	24	25	24	27	24	26	24	26	24	29	24
	direct	25	24	25	24	27	24	25	24	26	24	27	24	26	25	26	25	28	25	27	26	27	26	29	26
12 ACH	indirect	26	25	27	25	28	25	28	26	28	26	30	26	28	28	28	28	30	28	29	28	29	28	31	28
	dir-indirect	23	23	24	23	25	23	24	23	24	23	25	23	24	24	25	24	25	24	25	24	25	24	26	24
A/C	PVAVS	24	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	24	25	24	25	24	24
Evap.	PVAVS + ind/OA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	24	25	24	24	24	24	24	24
Pre-	PVAVS + ind/RA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	25	24	25	24	24	24	24	24	24
Cooling	PVAVS + ind/dir/OA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	25	24	24	24	24	24	24	24	24
	PVAVS + ind/dir/RA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	25	24	24	24	24	24	24	24	24
	·																								
Percent	hours undercooled																								
	direct	0	0 0 1 0 0 0 1 0 0 0 0 0		3	0	0	0	2	0	4	0	3	5	5	5	. 8	5	4	5	6	3.5	9	5	
4 ACH	indirect	0	0         0         1         0           0         0         1         0           0         0         0         0         0           0         0         0         0         0           0         0         0         0         0		- 4	0	1	0	2	0	5	0	4	7	~7	<b>~</b> 7	9	7	5	7	8	<b>7</b>	×10	<b>7</b> 7	
	dir/indir	0	0 0 1 0 0 0 0 0 0 0 0 0		2	0	0	0	1	0	3	0	2	4	4	4	<b>. 7</b> ,	4	3	4	<b></b> 5	4	8	4	
	direct	0	0 0 0 0 0 0 0 0		0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	1	0	2	0	
8 ACH	indirect	0	0 0 0 0 0 0 0 0 0 0 0 0		1	0	0	0	0	0	1	0	0	0	1	0	3	0	1	0	2	0	3	0	
	dir/indir	0	0 0 0 0 0 0 0 0 0 0 0 0		0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	
	direct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 ACH	indirect	0	0	0	0	0	0	0	0	0	0	0	0	C	0	0	0	1	Û	0	0	0	Q	1	0
	dir-indirect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A/C	PVAVS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Evap.	PVAVS + ind/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-	PVAVS + ind/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cooling	PVAVS + ind/dir/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ť	PVAVS + ind/dir/RA	0	0	0	0	0	0	0	0	0	Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0
																			-						
Cooling	and Fan Energy Use (k	Wh/m	12)																						
<u> </u>	direct		4		5	, i	3		4		5		5	1	12	1	3	1	3	1	2	1	3	1	4
4 ACH	indirect		5		7		3		6		8		9	1	17	1	8	1	9	1	7	1	9	1	9
	dir/indir		5 7 6 7		7		}		7		B	1	0	2	20	2	1	2	2	2	20	2	2	2	2
	direct	-	6 7 4 5		-	7		5		6	:	B	1	14	1	5	1	6	1	4	1	6	1	7	
8 ACH	indirect		4 5 6 8		1	0		7		9	1	1		20	2	2	2	3	2	1	2	3	2	4	
	dir/indir		6 8 6 8		1	1		7		9	1	2		22	2	4	2	6	2	3	2	5	2	6	
	direct	-	6 8 4 5			7		5		6		8	1	4	1	6	1	7	1	5	1	6	1	8	
12 ACH	indirect		6		8	1	1		8		0	1	2	2	21	2	3	2	25	2	2	2	4	2	6
ļ	dir-indirect		6		8	1	1		7		9	1	3	1	22	2	5	2	7	2	23	2	6	2	8
A/C	PVAVS	2	20		23	3	4	2	25	3	10	4	4	:	38	4	1	5	52	4	14	4	8	6	3
Evap.	PVAVS + ind/OA	1	9		22	3	2	2	4		8	4	3		36	3	9	4	9	4	12	4	6	6	j <b>1</b>
Pre-	PVAVS + ind/RA	2	1		24	3	6	9	7		1		7		10		4	<b>8</b> 105	4	6	6	1880 S	1	6	7
Cooling	PVAVS + ind/dir/OA	1	7		20	3	0	2	22	1	26	4	0		34	3	37	4	6	3	9	4	3	5	6
	PVAVS + ind/dir/RA	翻2	20] 麗麗	<b>M</b>	23	See 3	5		6		0		6		39		2		3	4	5		0	题16	5

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	Location	i –		_		_						H	alif	av Ñ	19						_	-			
	internal anima	<del> </del>		_			<b>.</b>								10										
	Internal gains	┝──				iow in I	tern	ai ga	ns	r				┣──			nı	gn in I	terna	al gai	ns	<b>r</b>			
1	solar gains	-	- 10	w L			mec	lium	······	<u> </u>	hi	gh l		<b>I</b>		<del>w</del>			mee	dium		<u> </u>	hi	gh	
1	hida location	ni	gn Loor		w loor		in oor	10	w	nı	gn Iaar	10	w	nı	gn Iarr		w	hi	gh L	10	w.	hi	gh I		w
Maximu	n Indone Temporetures	per (C)	COI	lhei	COL	per	COL	per	cor	per	cor	per	COL	per	COF	per	COL	per	cor	per	cor	per	cor	per	cor
Maximu	ation of temperatures					10	-			111		Deer Land		W	law alla		WY 2	Wr a la		XX - 1-	<b>X</b> Y 11	1			
	direct	27	26	28	26	₩31 Жор	26	29	26	<u>%30</u>	26	134	26	<u>8</u> 31	@30	32	£30	₩34	₿30	₩33	.∭31	35	₩31	<u>_</u> 37	<b>31</b>
ACH	dialization	20	20	29	20	102	20	<b>3U</b>	27	<b>31</b>	27	134	27	₩ 32	<u>@30</u>	33	<u>%</u> 30	135	<b>%</b> 30	<b>34</b>	32	35	₩32	38	\$32
<u> </u>	dir/indir	21	23	20	25	梁37: 梁37:	25	29	20	<u></u> %30	20	#33	26	₩30	29	₩32	29	834	29	\$33	**31	34	∦31	<u>_ 37</u>	∭31
	direct	26	25	27	25	29	25	27	26	28	26	<b>31</b>	26	28	27	29	27	31	27	∭30	28	∭31	28	₩33	28
8 ACH	disfination	27	26	28	26	29	26	28	26	29	26	¥31	26	29	28	<b>%30</b>	28	32	28	<u>@31</u>	29	31	29	33	_29
	din/mon	20	25	21	20	28	25	21	25	28	25	<b>%30</b>	25	28	27	29	27	§30	27	29	28	<b>%30</b>	28	₩32	28
12 4 64	direct	26	25	27	25	28	25	27	25	27	25	29	25	28	27	28	27	29	27	28	27	29	27	31	27
12 ACH	dia indiacat	2/	26	27	26	28	26	27	26	28	26	₩30	26	28	27	29	27	<b>©30</b>	27	29	28	30	28	31	_28
A 10	air-indirect	20	25	26	25	21	25	26	25	27	25	29	25	27	26	28	26	29	26	28	27	28	27	∭30	27
A/C	PVAVS	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	25	24	25	24	24	24	24
Evap.	PVAVS + ind/OA	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	24	25	24	24	24	24	24	_24
Pre-	PVAVS + Ind/RA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	24	25	24	24	_ 24	24	24	24
Cooning	PVAVS + ind/dir/UA	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	24	25	24	24	24	24	_24	24
L	FVAVS + ING/GI//RA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	25	24	25	24	24	24	_24	24	24
				_																					
Percent	nours undercooled			<u> </u>		S000 22						Manager 1		1000		10.007 C		141110000	-						
	direct	0	0	2	0	300 S	0	1	0	2	0		0	8		<u></u> 10	8	<u>A</u> h	8	<b>3</b>	WW 8	×10	8 8	<u> </u>	8 11
4 ACH	Indirect	1	0	2	0	MK 5	0	1	0	3	0	<b>M</b> 6	0	<b>8 10</b>		10	<b>8 M</b>	12	10	<b>M</b> .9	<u>()))</u> 9	10	11119	93	APAL 9
	dir/indir	0	0	1	0	4	0	0	0	2	0	())))(5	0	<i>翻</i> 17	##\$ <b>7</b>	<i>测</i> 机9	8//	<u>ş</u> ki	<b>3</b> 8	纖7	1	<b>%</b> }9	8 100	ઉદ્ય	8
	direct	0	0	0	0	_1	_0	0	0	0	0	1	0	1	0	1	0	3	0	1	0	2	0	3	0
8 ACH	Indirect	0	. 0	0	0	1	0	0	0	0	0	1	0	1	1	2	1	4	1	2	1	3	1	4	1
Ļ	dir/indir	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	3	0	0	0	1	0	3	0
	direct	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	_ 0
12 ACH	indirect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	1	0	2	0
	dir-indirect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Û	0	0	0	0	0	0
A/C	PVAVS	0	0	0	0	0	_ 0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Evap.	PVAVS + ind/OA	0	0	0	0	0	_0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-	PVAVS + ind/RA		0	0	0		0	0	0	0	0	- 0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cooling	PVAVS + Ind/dir/OA	0	0	0	0	0	0	0	0	0	- 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PVAVS + Ind/dir/RA	U	U	0	U	U	0	U	0	0	0	0,	0	0	0	0	0	0	0	0	0	0	0	0	0
Casting		A11. 1						· · ·																·	
Cooling	ano ⊩an Energy Use (k)	n/n/m	12) . '		_		<u></u>			_							_					_			
4.400	airect				<u>.</u>	- 6		5				6	5	9		1	<u></u>	1	0	9	)	1	0	10	0
ACH	diclindia		,	<u> </u>	<u>}</u>	7		6	۱ ۱	7				1	1	1	2		2	1	2	1	2	1:	3
		· · · · · ·			3	9	_		_	8		9		1.	4	1.	5	1	5	1:	5	1	6	1	ô
	direct		2	•	; 	7			5	6	;	7		1	1	1:	2	1	3	1:	2	1	3	1	4
8 ACH	indirect			~	5	9	-			8	•	1	0	1	5	1	6	1	7	1	5	1	6	13	<u></u>
	dir/indir	6	•	5	,	11	_	8		9	<u>'</u>	1	1	1	8	1	9	2	0	1	9	2	0	2	1
	direct	5	5		3	8		6		6	5	8		1:	2	1	3	1.	4	1	3	1.	4	1:	5
12 ACH	Indirect		<u> </u>	8	<u> </u>	10		8		9		1	1	1	6	1	7	1	9	1	7	1.	8	1!	)
	air-indirect	<u> </u>		\$	'	12		8		1	U	1:	2	1	9	2	U	2	2	2	0	2	1	2	3
A/C	PVAVS	1	6	1	8	28		1	9	2:	2	3:	5	2	9	3	2	4	0	37	2	3	6	41	3
Evap.	PVAVS + ind/OA	C.HHH	6	1	8	28		細肌19	9.00	2	3.000	3	<b>6</b> ((()))	3113	0.000	利用[3]	2.000	4	0.00	識[3:	3 22	<b>#</b> ¥3	6	翻 41	328
Pre-	PVAVS + ind/RA	1000	7.前期	111111	9/////	29	100	制制 2		MA#2:	3,000	100 3	7.00			3	4測期	4	2.000	3	4 🛲	3	8 📖	1111 50	) <b>III</b>
Cooling	PVAVS + ind/dir/OA	1	6 	1	8	28	ADBMS.	1	9	2:	2	3	5	· · · · · · · · · · · · · · · · · · ·	9.000		2	4	0 ////	32	2	<b>1</b> 3	6 🕷	47	!
	PVAVS + ind/dir/RA	1000	化開閉	1.1111	9.M#	潮129	11114	翻版2	の意識	绷蹼2;	3.湖鄉	關制31	7.88	調整3	1.翻版	翻[3]	4 劉熙	翻4	2.職業	翻34	4 編纂	翻訳3	820	<b>NN 5</b> (	1.難得

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	Location											То	ron	to C	)N										
	internal gains				1	ow ir	ntern	al ga	ins								hiç	gh inf	terna	l gai	ns				
	solar gains		lo	w		_	med	lium			hi	gh		_	lo	w			med	lium			hig	gh	
	Inertia	hig	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	*	hi	gh	la	W	hi	gh	lo	*
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor
Maximun	n Indoor Temperatures	(C)							•																
	direct	29	27	30	27	\$31	27	\$30	28	31	28	33	28	圓31	<b>3</b> 30	¥32	30	34	30	233	31	233	31	35	<b>3</b> 31
8 ACH	indirect	29	28	30	28	\$32	28	231	29	31	29	33	29	32	31	33	\$31	34	31	33	32	34	232	3C	32
	dir/indir	28	26	29	26	31	27	29	27	30	27	32	27	31	30	31	230	33	30	32	30	33	30	34	30
	direct	28	27	29	27	\$31	27	30	28	30	28	32	28	31	<b>\$</b> 30	31	₩30	<b>¥32</b>	830	<b>\$</b> 32	31	<b>¥32</b>	31	333	₩31
12 ACH	indirect	29	28	\$30	28	31	28	30	28	31	28	232	28	831	30	32	\$30	33	30	32	31	33	31	34	\$31
	dir-indirect	28	26	29	26	\$30	26	29	27	29	27	31	27	830	29	\$30	29	32	29	31	30	31	30	32	30
	direct	29	27	30	27	<b>3</b> 31	27	\$30	28	<b>8</b> 31	28	32	28	¥31	₩30	231	\$30	\$32	₩30	\$32	3í	<b>3</b> 32	<b>2</b> 31	33	¥31
16 ACH	indirect	29	28	\$30	28	32	28	\$31	29	31	29	832	29	32	831	32	31	33	Ø31	32	332	33	\$32	34	32
	dir-indirect	28	27	29	27	\$30	27	29	28	30	28	31	28	\$30	29	30	29	31	29	231	30	31	30	32	30
A/C	PVAVS	25	25	25	25	25	25	24	25	24	25	24	24	25	26	25	26	25	26	24	25	24	25	24	25
Evan	PVAVS + ind/OA	25	25	25	25	25	25	24	25	24	25	24	24	26	27	26	27	26	27	25	26	25	26	24	25
Pre.	PVAVS + ind/RA	25	25	25	25	24	25	24	25	24	25	24	24	25	26	25	26	25	26	24	25	24	25	24	25
Cooling	PVAVS + ind/dir/OA	25	25	25	25	25	25	24	25	24	25	24	24	26	26	26	26	25	26	24	25	24	25	24	25
o o o o i i i g	PVAVS + ind/dir/RA	25	25	25	25	24	25	24	25	24	25	24	24	26	26	25	26	25	26	24	25	24	25	24	25
							-+																		
Percent	hours undercooled			_																					
- dreene	direct	2	1	4	1	200 B	1	3	1	4	1	ST G	1	2.7	<b>36</b> 6	S. 8	<b>2</b> 6	્યવ	<b>8</b> 6	<b>8</b> 7	199 <b>5</b> 5	8	<b>1</b> 115	<b>M</b> 9	6
8 ACH	indirect	2	1	25         25         25         25           25         25         25         24           25         25         25         25           25         25         25         25           25         25         25         24           1         4         1         16           1         5         2         17           1         2         1         15           1         2         1         15           1         2         1         15           1         2         1         25           0         1         0         2           0         1         0         2           0         1         0         2			4	1 2	1965 1965	2	<b>8</b> 7	2	6 8	17	9	***7	10	1977	<b>8</b>	1237	9	7	<b>%10</b>	7	
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12 404	indiract	2	1	- 2	1	875	1	<u>'</u>		- 1	1				- 4	\$¥6	4	227	4	- 		W76	Å	1000 7	- 4
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		, v	v	v	Ű	Ļ						-	•	÷		-	26.27	<u> </u>		<u> </u>		, i			
Cooling	and Ean Energy Line /k	Mble	.21											_											
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8 ACH	indirect		2		4		6		13		14		6	2	1		2		3		21		2		3
0 ACh	dir/indir		5		7	1	19		15		7		9		6		7		9		27		8	2	9
	diract		1		2		14		11		12		4		0		0		1		10				1
42 404	arrect		1 c		<u>-</u>		20		16		12	-	14 20		5				10		26		.0	2	
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16 ACH	Indirect		ð		9		23		10	l ÷	20		25		22		5		18		30		16	- 3	3
			3	H	i i	+	17	$\frac{1}{1}$	13	┢┉╡	10	<del>L í</del>	1.0				2		3		42		7	<u> </u>	
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Evap.	PVAVS + Ind/OA		2		0.0		00		23 12	┢═╴	10		+3 (2)	E			4		79) - 1 71		+->) 2/2	ľ	( <b>1</b> 11)		
Pre-	PVAVS + IND/RA		دی در		5				43 <b></b> 24				+9. 13	1	0				/+ ./		*** 201 ( 1) 10 1		775		<u>്ജ്ജ</u> ഗ
Coomg	DVAVS + ind/dir/UA		2		6		.0 17)		26		20		ia 🗖		n i		5		5		44	E	10		2
1	IL AVA + IUU/UU/KA	1 100 4		昭和三 4		Contract of			- J	1 1000		Contraction of the local division of the loc	1. 196	, <b>199</b> .°		5 (Real of the second s		25588 V	- 1 A A	Riccia		1 <b></b>		NEW COL	- 2033

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	Location											Edn	non	iton	AB										
	internal gains				Ī	ow ir	nterna	al ga	ins								hig	gh int	erna	l gair	15				
Į ;	solar gains	l	lo	w			med	ium			hi	gh			lo	w			med	lium			hi	ցի	
1	Inertia	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	ě	hi	gh	lo	w
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	сог
Maximur	n Indoor Temperatures	(C)																							
	direct	26	25	27	25	∭30	25	28	25	29	25	32	25	₿30	28	\$31	29	\$33	29	32	30	33	₹30	86	\$30
4 ACH	indirect	27	25	28	25	31	25	28	26	₿30	26	\$33	26	31	29	32	29	34	29	32	31	34	31	86	<b>3</b> 1
	dir/indir	26	24	27	24	29	24	27	24	28	24	31	24	29	28	30	28	32	28	\$31	29	\$32	29	85	29
	direct	25	24	26	24	27	24	26	24	26	24	29	24	27	26	28	26	29	26	28	26	29	26	31	26
8 ACH	indirect	26	25	26	25	28	25	27	25	27	25	30	25	26	27	29	27	30	27	29	27	\$30	27	32	27
	dir/indir	24	24	25	24	27	24	25	24	26	24	28	24	26	25	27	25	29	25	27	25	28	25	30	25
	direct	24	24	25	24	26	24	25	24	25	24	27	24	26	25	26	25	28	25	26	25	27	25	29	25
12 ACH	indirect	25	24	26	24	27	24	26	25	26	25	28	25	27	26	27	26	29	26	28	26	28	26	\$30	26
	dir-indirect	24	23	24	23	26	23	24	23	25	23	26	23	25	24	25	24	27	24	25	24	26	24	28	24
A/C	PVAVS	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	25	25	25	24	24	24	24	24	24
Evap.	PVAVS + ind/OA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	24	25	24	24	24	24	24	24
Pre-	PVAVS + ind/RA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	25	25	24	25	24	24	24	24	24	24
Coolina	PVAVS + ind/dir/OA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	25	24	24	24	24	24	24	24	24
	PVAVS + ind/dir/RA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	25	24	24	24	24	24	24	24	24
ļ		L																							
Percent	hours undercooled						_														_	_			
	direct	0	O	1	0	4	o	1	0	2	0	4	0	1005	4	7	4	1	<b>3</b>	<b>8</b> 85	4	<b>8</b>	4	16	<b>8</b>
4 ACH	lindirect		0	2		<b>3</b> 5	0	1	0	3	0	<b>60</b> 5	0	8	6	<b>8</b>	6	1	6	2007	<b>6</b>		<b>8</b> 6	10	
	dir/indir	0	0	1	Ō	3	Ō	0	0	1	0	4	0	4	3	6	3		4	5	3	<b>8</b> 7	3	<b>T</b>	4
	direct	0	0	0	0	1	o	0	0	0	0	1	0	0	0	1	0	3	0	1	0	1	0	3	0
8 ACH	indirect	0	0	0	0	1	0	0	0	0	0	2	0	1	0	2	0	3	0	1	0	2	0	4	0
	dir/indir	0	0	0	0	0	ō	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	2	0
	direct	0	0	0	0	0	0	0	0	0	0	0	0	ō	0	0	0	1	0	L D	0	0	0	1	0
12 ACH	indirect	l o	0	0	0	0	0	0	0	0	0	1	0	ō	0		0	1	0	Ō	0	1	0	1	0
	dir-indirect	Ō	0	0	0	0	o	0	0	0	0	0	0	Ō	0	0	0	0	0	Ō	Ő	0	0	0	0
A/C	PVAVS	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Evap.	PVAVS + ind/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-	PVAVS + ind/RA	Ō	0	0		0	Ō	0	0	Ō	0	0	0	0	1	0	1	0	0	0	0	0	Ō	0	0
Cooling	PVAVS + ind/dir/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PVAVS + ind/dir/RA	0	0	0	ō	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Ó
	·																								
Cooling	and Fan Energy Use (k	Wh/n	12)				_																		
<b>—</b>	direct		4		5	(	6	-	4		5	(	5	1	B		9	1	0	ç	)		9	1	0
4 ACH	indirect		5		6	8	6	1	6		7	8	3	1	1	1	1	1	2	1	1	1	2	1	3
	dir/indir		6		7		9		7	1	в	9	)	1	3	1	4	1	5	1	4	1	5	1	6
	direct		5		5		7	:	5		6	8	3	1	0	1	1	1	2	1	1	1	1	1	3
8 ACH	indirect		6		7	1	0	•	7		B	1	0	1	3	1	4	1	6	1	4	1	5	1	7
[	dir/indir		7		8	1	1		7		9	1	1	1	5	1	7	1	9	1	6	1	7	2	0
	direct		5		6	1	8		5		6	{	3	1	0	1	1	1	3	1	1	1	2	1	4
12 ACH	indirect		7		8	1	1		7		9	1	1	1	4	1	6	1	8	1	5	1	6	1	8
	dir-indirect	t -	7		9	1	2		8		9	1	2	1	6	1	7	2	0	1	7	1	8	2	1
A/C	PVAVS		6		9	2	9	2	20	2	4	3	8	2	6		9	3	9	3	0	3	4	4	8
Evan.	PVAVS + ind/OA		5		8	-	8	1	9		2	3	6		5	2	7		7	2	9	3	2	4	6
Pre-	PVAVS + ind/RA		6 10		9	3	0	£1072	1	2000	4 108	3	9 🕷	2	7	- 	0	<b>M</b> 4	0.0	3	1	8. S	5	5	0
Coolina	PVAVS + ind/dir/OA	1	4	1	7	2	6	1	8	2	1	3	4	2	3	2	6	3	4	2	7	3	0	4	3
	PVAVS + ind/dir/RA	1	5	1	8	2	8	1	9	2	2	3	6	2	5	2	8	3	7	2	9	3	2	4	6
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	Location											Pe	orto	PO	R										
	internal gains				I	ow ir	iterna	al ga	ins								hi	gh in <sup>.</sup>	terna	l gai	ns				
	solar gains		lo	w			med	lium			hig	gh			lo	w			med	lium			hig	gh	
	Inertia	hi	gh	la	w	hig	gh	lo	w	hi	gh	lo	¥	hi	gh	lo	×	hi	gh	la	w	hi	gh	lo	w
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	рег	cor	per	cor	per	cor	per	cor	per	cor
Maximun	n Indoor Temperatures	(C)																							
	direct	28	27	29	27	30	27	29	28	30	28	31	28	32	32	33	32	33	32	34	33	34	33	36	33
4 ACH	indirect	29	29	30	29	31	29	831	\$30	31	30	\$32	30	33	34	34	34	34	<u>34</u>	۳. St	<u> I</u>	36	39	36	35
	dir/indir	27	26	27	26	28	26	28	27	28	27	30	27	31	31	31	31	32	31	32	32	33	32	33	32
	direct	27	26	27	26	28	26	27	26	28	26	29	26	29	29	29	29	30	29	30	330	<b>30</b>	30	31	30
8 ACH	indirect	28	28	28	28	29	28	29	29	30	29	31	29	31	31	31	31	32	31	32	32	32	32	33	32
	idir/indir	25	25	25	25	26	25	26	25	26	25	27	25	28	27	28	27	28	27	28	28	29	28	29	28
	direct	26	26	26	26	27	26	27	26	27	26	28	26	28	27	28	27	29	27	29	28	29	28	29	28
12 ACH	indirect	28	27	28	27	29	27	29	28	29	28	30	28	30	29	30	29	30	29	31	30	31	30	32	30
	dir-indirect	25	25	25	25	25	25	25	25	25	25	26	25	26	26	27	26	27	26	27	27	27	27	28	27
A/C	PVAVS	25	25	25	25	24	25	24	25	24	25	24	25	25	26	25	26	25	26	25	25	24	25	24	25
Fuen	PVAVS	24	25	2.5	25	24	25	24	24	24	24	24	24	25	25	25	26	25	25	24	25	24	25	24	25
Evap.		24	20	24	20	24	20	24	24	24	24	24	24	25	25	25	25	25	25	24	25	24	25	24	25
Pre-		24	20	24	20	24	20	24	24	24	24	24	24	23	25	25	25	25	25	24	25	24	25	24	25
Cooling	PVAVS + ind/dir/OA	24	20	24	20	24	20	24	24	24	24	24	24	25	25	25	25	20	25	24	25	24	25	24	25
	PVAVS 7 Ind/din/RA	24	25	24	23	24	23	24	24	24	24	24	24	23	2.3	٤J	23	24	23	24	23	24	23	2-	2.5
																			-						
Percent	hours undercooled		3 3 4 3 5 4 5 5 5 5 7 2 1 3 1 4		-		r .	19.00° -		285 a						~	6	07	1.00	í oð	ad	r del			
	direct	3	3     3     4     3     5       4     5     5     5     5       2     1     3     1     4       1     0     1     0     2		3	4	4	3 5 	4	10,6	4	<u> </u>		18	24	98	24		25	60	26	18	26		
4 ACH	indirect	4	3         3         4         3         3           4         5         5         5         5         7           2         1         3         1         4		£\$ <b>%</b> 5	£\$\$5	∛≷5	28% <b>6</b>	<b>\$</b> **6	8	源《6	<u>99</u>	25	20	25	19	25	<u>88</u>	3	20	20	19	<u> </u>		
	dir/indir	2	5 5 5 7 1 3 1 4 0 1 0 2		1	2	2	3	2	鬱(5	2	16	23	17	28	U.	25	<u>96</u>	25	8	25	18	26		
	direct	1			2	0	1		2	1	2	1	灏5	<b>%</b> 6	6 %	6	8	* 6	<b>3</b> 886	8.26	6	<b>6</b>	<b>8.27</b>	6	
8 ACH	indirect	2	2	2	2	3	2	2	2	3	2	3	2	<u>7</u> 7	9	8	9	9	9	<b>8</b> 8	<u>%</u> 9	8 🛞	×39	9	<u> </u>
	dir/indir	0	0	0	0	1	0	0	0	0	0	1	0	3	4	4	4	<b>%</b> 5	4	4	4	4	4	5	4
	direct	0	0	0	0	1	0	1	0	1	0	1	0	2	2	2	2	3	2	2	2	3	2	3	2
12 ACH	indirect	1	1	1	1	2	1	1	1	2	1	2	1	4	4	4	4	5	4	4	4	4	4	<b>教育5</b>	. 4
	dir-indirect	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	1	1	1	1	1	2	1
A/C	PVAVS	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	2	0	1	0	1	0	0
Evap.	PVAVS + ind/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	0	0	0	0	0
Pre-	PVAVS + ind/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	0	0	0	0	0
Cooling	PVAVS + ind/dir/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0
	PVAVS + ind/dir/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0
Cooling	and Fan Energy Use (k'	Wh/n	12)																						
	direct		7		8		8		8	· · ·	8		8	1	5	1	5		5		15	1	5	1	5
4 ACH	indirect	1	0	1	1	11	1		11	1	1	1	2	1	9	2	0	1	9	2	20	2	20	1	9
	dir/indir	1	2	1	3	1	3		13	1	3	1	4	2	15	2	5	2	24	2	25	2	25	2	4
	direct	1	12 13 9 10		1	1		10	1	1	1	1	2	2	2	2	2	22	2	22	2	3	2	2	
8 ACH	indirect	1	9 10 14 15		1	6		15	1	6	1	6	3	0	3	0		50		30	3	0	3	0	
	dir/indir	1	14 15 14 15		1	6		15	1	6	1	8	3	15	3	6	3	5	3	36	3	17	3	6	
	direct	1	14 15 10 11		1	2	-	11	1	2	1	3	2	!5	2	6		25	2	25	2	26	2	6	
12 ACH	indirect	1	6		7	1	8		17		8		9	3	5	3	6		15		36	3	6	3	6
	dir-indirect	1	5		7	1	8		17		8		9	3	9	4	10		10	4	<b>10</b>	4	11	4	1
A/C	PVAVS	2	28		0	3	6	:	33		5		12	5	57	i s	9	t e	33	6	51	e	3	6	9
Evan	PVAVS + ind/OA		18		10		6		32		4		11		6		i7		52	-	50	6	2	6	7
Pre-	PVAVS + ind/RA	380 2	9		1麗麗		7		33		5		3		8	8 K 6	io 2018	888 (	<b>i</b> 4		52		438	818V 6	9)##
Cooling	PVAVS + ind/dir/OA		7		9		5				3				15	5		6	51	and the l	59	6	1	6	6
Sooning	PVAVS + ind/dir/RA	<b>3</b> 33	0		 51000		8		34 🎆		6		4		59 <b>)</b>	8	0		5		63		5	業務7	0355

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	Location											Lis	sbo	n P(	DR										
	internal gains					low in	itern	ial ga	ins								hi	gh in	terna	al gai	ns		-		
	solar gains		lo	w			med	dium			hi	gh			lo	w			med	tium			hi	gh	
	Inertia	hi	gh	lo	w	hie	gh	lo	w	hi	gh	١o	w	hig	gh	lo	w	hi	gh	lo	w	hĭ	gh	lo	w
	bldg location	per	сог	рег	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	рег	cor	per	cor	per	cor	per	cor
Maximu	m Indoor Temperatures	(C)						•											<u> </u>						
	direct	29	27	29	27	32	27	\$30	28	31	28	\$33	28	831	<b>30</b>	32	\$ 30	33	30	\$32	\$30	×33	\$30	85	×30
8 ACH	indirect	30	28	31	28	33	28	\$31	29	32	29	35	29	32	31	33	31	95	31	34	\$32	85	32	87	32
	dir/indir	27	26	28	26	\$30	26	29	26	29	26	32	26	30	28	31	28	32	28	31	29	32	29	34	29
	direct	28	27	29	27	30	27	29	27	₿30	27	₩32	27	30	29	830	29	832	29	₿31	29	831	29	\$33	29
12 ACH	indirect	29	28	\$30	28	32	28	31	29	\$31	29	33	29	31	830	32	30	33	30	32	W31	<sup>**</sup> 33	31	হিৰ	31
	dir-indirect	27	25	27	25	29	25	27	26	28	26	30	26	28	27	29	27	30	27	29	27	30	28	31	28
	direct	28	27	29	27	<b>30</b>	27	29	28	30	28	\$31	28	29	29	30	29	\$.1	29	\$30	29	\$31	29	\$ 32	
16 ACH	indirect	30	28	\$30	28	\$32	28	31	29	32	29	33	29	<b>3</b> 1	<b>3</b> 0	\$31	\$30	33	\$30	\$ 32	\$31	\$ 33	31	34	31
	dir-indirect	27	26	27	26	29	26	27	26	28	26	29	26	28	27	28	27	30	27	29	27	29	27	31	27
A/C	PVAVS	25	25	25	25	25	25	24	25	24	25	24	25	26	26	26	26	25	25	25	25	25	25	24	25
Evan	PVAVS + ind/OA	25	25	25	25	25	25	24	25	24	25	24	25	25	26	25	20	25	25	23	25	20	25	24	20
Pre-	PVAVS + ind/RA	25	25	25	25	25	25	24	25	24	25	24	20 24	25	20	20	20	23	20	24	20	24	20	24	20
Cooling	PVAVS + ind/dir/OA	25	25	25	25	25	25	24	25	24	25	24	24	25	20	20	20	20	23	24	20	24	20	24	24
, cooling	PVAVS + ind/dir/RA	25	25	25	25	25	25	24	25	24	25	24	24	25	20	25	25	25	25	24	20	24	23	24	24
L			2.5	20	20	20	20	24	23	24	20	24	24	23	23	2.	23	٤J	20	24	ZJ	24	24	24	24
Baraant	hours underseeled		_																						
Percent	nours undercooled		4	0000		-100 C				1990 W		10110		2000-0	50000	()%	NoW		10.28	New York		1.00	w.c22	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	110-
	direct	3 30% r	1	Sill D		8 110	1	3		WF 5	1	8 100	1	<u>8</u> 9	\$\$\$ <b>7</b>		3107	15	<b>3</b> 7	9	<b>7</b>	5	7	<u> </u>	7
а АСН	dialization	1000	3	ann o	3	301U	3	<b>8885</b>	2	381R B	2	10 10	2	1011V	@10 @///	<u></u>	<b>%10</b>	<u> </u>	×10	<u>. 16.</u>	<u>889</u>	13	<u>9</u>	_100	<u>.</u> , 9
		4	0			MINE.	U O	2	U	3	0	<i>()))</i> , 0	U		MR 3	11111	<i>\$1111</i> ,5		)(()()) <b>&gt;</b>		/////5	<b>30%9</b>	\$##(5	20	/////*5
42.401	direct	<u> </u>	0	2	0	4	0	2	1	2	1	4	1	4	3	<b>305</b>	3	8	3	4	3	× 5	3	27	3
12 ACH	indirect	3	1	4	2	₩₩6 •	2	3	2	4	2	<b>6 M</b>	2	<b>886</b>		· 御歌:7.	¥¥5	<b>%10</b>	A#5	.≋≪6	4	<b>%</b> ⊸7	4		4
	dir-indirect		U	1	0	3	0	1	0	1	0	3	0	3	1	4	1	<b>#</b> \$6	1	3	1	3	1	<b>@</b> \$6	1
	direct	1	0	1	0	3	0	1	0	1	0	3	0	2	1	3	1	\$ 5	2	3	1	3	1	4	1
16 ACH	indirect		1	2		4	1	2	1	3	1	-4	1	4	3	纖 5	3	26	3	4	3	<u>}</u>	3		3
	air-indirect	•	U	U	U	1	0	0	U	0	0	1	0	1	0	1	Û	3	0	1	0	2	0	3	0
A/C	PVAVS	0	3	0	3	0	2	0	1	0	1	0	0	1	6 🎊	1	<b>%</b> (6	0	4	0	2	Û	1	0	0
Evap.	PVAVS + ind/OA	0	2	0	2	0	2	0	. 0	0	0	0	0	0	5	0	5	0	3	0	1	0	0	0	0
Pre-	PVAVS + ind/RA		2	0	2	0	2	0	0	0	0	0	0	0	WW 5	0	MW 5	0	3	0	1	0	0	0	0
Cooling	PVAVS + ind/dir/OA		2	0		0	1		0	0	0	0		0	4	0	4	0	2	0	0	0	0	0	0
L	PVAV5 + ind/dir/RA	U	2	0	2	0	1	0	0	]	0	0	0	0	4	0	4	0	2	0	0	0	0	0	0
																							_		
Cooling	and Fan Energy Use (ki	Wh/m	2)					-			_							-							
	direct	1	4	1	6	1	8	1	4	1	6	1	8	2	5	2	6	2	7	2	5	2	6	2	7
8 ACH	indirect	2	0	2	2	24	4	2	0	2	2	2	4	3	3	3	4	3	5	3	2	3	4	3	5
	dir/indir	2	2	2	5	29	9	2	2	2	5	2	8	4	D	4	2	4	4	4	0	4	2	4	4
	direct	1	6	1	8	2.	1	1	6	1	8	2	0	29	9	3	0	3	2	2	8	3	0	3	2
12 ACH	indirect	2	3	2	5	29	•	2	3	2	6	29	9	3	9	4	1	4	3	3	9	4	1	4	3
	dir-indirect	2	4	2	7	33	3	2	5	2	8	3:	2	4	6	4	8	5	2	4	5	4	8	5	1
	direct	1	7	1	9	2	3	1	7	1	9	2	2	3	1	3	3	3	5	3	1	3	3	3	5
16 ACH	indirect	2	6	2	8	3	3	2	6	2	8	3	3	4:	3	4	6	4	9	4	3	4	5	4	8
	dir-indirect	2	6	2	9	3	5	2	6	2	9	3	5	4	9	5	2	5	6	4	8	5	1	5	5
A/C	PVAVS	3	8	4	3	5	•	4	4	5	1	7;	2	6	5	7	0	8	6	7	1	7	8	9	9
Evap.	PVAVS + ind/OA	3	7	4	2	5	3	4	4	5	0	7	2	6	4	6	9	8	5	7	0	7	7	9	9
Pre-	PVAVS + ind/RA	MW 3	9.86	4	4	6	D		5	<b>M</b> 5	1	<b>887</b>	4	6	7.200	<b>\$18</b> 7	2	8 111	8 🞆	<b>8867</b>	2 📖	<b>38</b> 7	9)))))	<b>3</b> 10	1
Cooling	PVAVS + ind/dir/OA	3	6	4	2	5		4	3	4	9	7	1	6	3	6	8	8	4	6	9	7	6	9	7
	PVAVS + ind/dir/RA		9)	4	5	8	2 100	111114	6	MW 5	3	7	6	6	3	挪狮7	3	9	0	<b>3</b> 7	498	8	1.	10	4 🛞

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	Location											Tra	app	es l	FR										
	internal gains					ow ir	nterna	al ga	ins								hig	gh int	terna	l gair	15				
	solar gains		lo	w		<b></b>	med	ium			hie	ah			lo	w			med	lium			hi	gh	
	Inertia	hig	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	¥	hi	gh	lo	w	hi	gh	lo	w
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	рег	cor	per	cor	per	cor	per	cor	per	cor	рег	cor
Maximur	n Indoor Temperatures	(C)										-		-						<u> </u>					_
	direct	24	24	25	24	28	24	25	24	26	24	30	24	27	26	28	26	30	26	29	26	30	26	33	26
4 ACH	indirect	28	27	29	27	32	27	30	27	31	28	34	28	¥32	32	833	32	36	32	34	33	39	33	37	33
	dir/indir	24	23	25	23	27	23	25	24	26	24	29	24	26	25	28	25	30	25	28	25	29	25	32	25
	direct	24	23	24	23	25	23	24	23	24	23	25	23	24	24	24	24	26	24	24	24	25	24	27	24
8 ACH	indirect	26	25	27	25	29	25	28	26	29	26	831	26	29	28	29	28	31	28	<b>8</b> 30	29	231	29	33	29
	dir/indir	23	23	24	23	24	23	24	23	24	23	25	23	24	24	24	24	25	24	24	24	24	24	26	24
<u> </u>	direct	23	23	23	23	24	23	23	23	24	23	24	23	24	23	24	23	24	23	24	23	24	23	25	23
12 ACH	indirect	26	25	26	25	28	25	27	26	28	26	29	26	28	27	28	27	29	27	29	28	29	28	31	28
	dir-indirect	23	23	23	23	24	23	23	23	23	23	24	23	23	23	24	23	24	23	24	23	24	23	24	23
A/C	PVAVS	24	25	25	25	25	25	24	24	24	24	24	24	25	26	25	26	25	25	24	25	24	25	24	25
Evan	PVAVS + ind/OA	24	25	24	25	25	25	24	24	24	24	24	24	25	25	25	25	25	25	24	25	24	25	24	24
Evap.	PVAVS + ind/DA	24	23	24	24	24	24	24	24	24	24	24	24	24	25	25	25	24	25	24	24	24	24	24	24
Cooling	PVAVS + ind/dir/OA	24	24	24	24	24	24	24	24	24	- 24	24	24	24	25	25	25	24	25	24	24	24	24	24	24
coomg	PVAVS + ind/dir/DA	24	24	24	24	24	24	24	24	24	24	24	24	24	25	24	25	24	25	24	24	24	24	24	24
	IL ALS THURSDARD	24	24	27			27	24	24	24	24	24			2.0	24	10		10						
Deveent	hours underscolod																								
Percent					_	25       25         24       24         24       24         24       24         24       24         24       24         20       1         0       1         0       0		-	6	•		2			4	No.	4	2350	4		4	1880 P	4	i Ko	4
		0	U	U	0	1 880 - 7	0	0		U Marie		<u>ک</u>		3	പ	8800 0298	്ഹ്	3819		4	1		07		4
4 ACH	indirect	3	1	3)#3		1. 1.		3		382.0	2	() () () ()	- 2	<b>.</b>	1 (D)	88.9 888.9	<u>।</u> (100	四位	2		4			1	-
		0	0	0	•		0	0	0		-	2		4	•	副連ち	1						-		-
	direct	0	0	0	0	0	0	0		0	0	0	0	0			0	U	0	0	0	0	0	1	- 0
8 ACH	indirect	0	0	1	0	3	0	1	0	1	0	3	0	3	2	4	2	326	3	3	2	4	2	<b>6</b>	2
	dir/indir	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	U	0	0	U U	U	0	0		0
	direct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
12 ACH	indirect	0	0	0	0		0	0	0	0	0	1	0			1	1	3	1		1	2	1	3	
	dir-indirect	0	U U	0	0	0	0	0	0	0	0	0	0	0	0	0	U	Ľ	U	U	U			U	
A/C	PVAVS	0	0	0	0	0	0	0	0	U	0	0	U	0	3	0	3	0	3	0	0	0	U	0	0
Evap.	PVAVS + ind/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	0	0	0	0	0
Pre-	PVAVS + ind/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cooling	PVAVS + ind/dir/OA	0	0	0	0		0	0		0	0	0	0		0	0	0	0	0		0	0	0	0	0
	PVAVS + ind/dir/RA	0	0	Û	0	0	0	0	0	0		0	U	U	0	0	U	0	0	ļŲ	Ū.	Ų	Q	U	0
										_															
Cooling	and Fan Energy Use (k	Wh/m	12)							-								-				_			
	direct	- 4	4		4		5		4		4		6	1	1	1	2		1	1	1	1	2	1	1
4 ACH	indirect	1	8		9	1	0		8		9	1	0	1	6	1	6		6	1	6	1	6	1	6
	dir/indir		6		7		8		6		7		9	1	6	1	7		6	1	6	1	7	1	7
	direct	6	4		7		5		4		5		6	1	2	1	3		3	1	2	1	3	1	3
8 ACH	indirect	1	0	1	4		3	1	0	1	1	1	3	2	1	2	2	2	2	2	1	2	2	2	2
	dir/indir	•	6		7		9		7		7	1	0	1	7	1	9	1	9	1	8	1	9	1	9
	direct	4	4		5		6		4		5		6	1	2	1	3	1	3	1	2	1	3	1	3
12 ACH	indirect	1	1	1	2	1	4	1	11	1	13	1	4	2	3	2	4	2	25	2	3	2	5	2	5
	dir-indirect		6	1	7		9		7		8	1	0	1	8	1	9	1	9	1	8	1	9	2	0
A/C	PVAVS	1	8	2	1		29	1	22	2	26	3	7	3	4	3	7	4	15	3	8	4	2	5	2
Evap.	PVAVS + ind/OA	1	8	2	21		29		22	2	25	3	6	3	3	3	6	4	3	3	7	4	1	5	1
Рге-	PVAVS + ind/RA	1	7	1	9	2	26		20	1	23	3	1	2	8	3	0	3	6	3	1	3	4	4	3
Cooling	PVAVS + ind/dir/QA	1	1	1	2	1	17		13	1	5	2	2	2	1	2	2	2	26	2	3	2	5	3	1
	PVAVS + ind/dir/RA	1	1	1	2	1	17		13	1	15	2	!1	2	20	2	2	2	26	2	2	2	4	3	0

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	Location								_		1	Car	pen	tras	s FF	2									
	internal gains		low low high low			low ir	ntern	al ga	ins								hi	gh in	terna	al gair	ns				
	solar gains		la	w			med	lium	_	Í	hi	gh			lo	w			mea	dium			hi	gh	
	Inertia	hi	gh	lo	w	hi	gh	ic	W	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	W	hi	gh	lo	w
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	сог	per	cor	per	cor	per	cor	per	cor	per	сог
Maximu	n Indoor Temperatures	(C)																		·					_
	direct	26	25	26	25	28	25	27	25	27	25	\$30	25	28	27	28	27	830	27	29	28	\$ 30	28	33	28
4 ACH	indirect	26	25	27	25	28	25	27	26	28	26	\$31	26	28	27	28	27	\$31	27	30	28	31	28	34	28
	dir/indir	25	24	26	24	27	24	26	25	27	25	₩30	25	27	27	28	27	30	27	29	27	30	27	\$33	27
	direct	25	24	25	24	26	24	25	24	26	24	28	24	26	25	26	25	28	25	27	26	28	26	₩31	26
8 ACH	indirect	25	24	26	24	27	24	26	25	26	25	29	25	27	26	27	26	29	26	28	27	29	27	\$32	27
	dir/indir	24	23	25	23	26	23	25	24	25	24	27	24	25	25	26	25	28	25	27	25	27	25	29	25
	direct	24	24	25	24	26	24	25	24	25	24	27	24	25	25	26	25	27	25	27	25	27	25	29	25
12 ACH	indirect	25	24	25	24	26	24	26	25	26	25	28	25	26	25	26	25	28	25	27	26	28	26	30	26
	dir-indirect	24	23	24	23	25	23	24	23	24	23	26	23	25	24	25	24	27	24	26	24	26	24	28	24
A/C	PVAVS	18	9	19	9	22	10	21	12	21	12	23	13	22	19	22	19	23	20	22	22	23	22	23	22
Evap.	PVAVS + ind/OA	18	9	19	9	22	10	21	12	22	13	23	13	22	20	22	20	23	20	22		23	22	23	22
Pre-	PVAVS + ind/RA	18	9	19	9	22	10	21	12	22	13	23	13	22	19	22	20	23	20	22	22	23	22	23	
Cooling	PVAVS + ind/dir/OA	18	9	20	9	22	10	21	12	22	13	23	13	22	20	22	20	23	20	22	22	23	22	23	22
	PVAVS + ind/dir/RA	18	9	20	9	22	10	21	12	22	13	23	13	22	20	22	20	23	20	22	22	23	22	23	22
1	· · · · · · · · · · · · · · · · · · ·																								
Percent	hours undercooled				6 3 8 7 5 8											-									_
	direct	111 A	1	3 6 3		<b>8</b> %8	3	###z	2	Se c	3	28 7	3	<b>**</b> *	a 1986	×10	10 Million	[ ad	83% n	86 A	all o	840	0.15	6	200 D
A ACH	indirect			6 3 0 7 5 0 6 2 0					4	1000	3	1000 r		0.111	38 J	×10	310 J		2003 20140	1000 B	3100 D	%10 %10	366 J		840
	dir/indir	4	2	6	6         3           7         5           6         2		2	100 U	2	3899 S	-4	200 7	- 4	311 B	20 A	a a		2010 2010	10	#84 5 80 B		3010 300 a	2008 9 2008 9		20 (M)
<u> </u>	direct	2	- 1	3 (1101) -	0         3         8           7         5         8           5         2         7		1	7	-	2	1			();() A	300.0	300 S	3 10 10 10 10	2011 C	1/18/0		2.00 2.00 2.00	100 C	2 //#8	300 0	2
8 ACH	indirect	3	2	3	2	305	2	3	2	3	2		2	885		Sill B	5	AM 7	3 8 8 8	÷	3	108 S	3	100 7	3
	dir/indir	1	-	1		2 1000	0	1	-	1		3	-	3197.2	2	2222 U	3000 J 2	2000 s	******	2 2 2 2 2 2	2 7	2000	- 4	1999 F	
<u> </u>	direct	1	- 0	1	0	2	0	1	0	1	0	2	- 0	2	2		~ ~	1963	2	2	4	-		1	-
12 ACH	indirect	2	- 1		1	2	1	2	1				1	2	2					2	' 2				
	dir-indirect	0	0	0	0	1	0		0	0	0	1	0		0			3			0	- 4		3	
A/C	PVAVS	- a	- 0	0	- 0	Ö	- 1	ů	0	0	0				ů N	-	0	0	- 0	- 0	0	-	0		
Evan	PVAVS + ind/OA	Ň	0	۰ ۵	0	0	0		0	Ň	0	, N	0	0	0		0	- 0	0	0	0	0	- 0	~	
Pro-	PVAVS + ind/RA	0	0	0	0	0		0	0		0	0	- 0		0		0	0		- 0	0	0	0	뷧	
Cooling	PVAVS + ind/dir/OA		0	0	0	0	- 0		0		0	- 0	- 0	0			- 0	- 0	- 0	0	0	0			
	PVAVS + ind/dir/BA		0	0		- 0	-	0	- U		0	0			0	0	0	- 0	0		0	0	0		-
L		L. "				v	•	v		. <u> </u>		•	v	v	v				v	v		v			
Cooling	and Fan Energy Lise (k)	Nhim	2)					_																	_
looning	direct	4	<u>^</u>	4	^	1	<u> </u>		<b>`</b>					4					~		•			_	
A ACH	indiract	1	1		4	1	4		,		,	3	-	4	0	1	_		<u> </u>	1		1	0		<u> </u>
	dir/indir	1	1	1	4		+	1	2	1	2	1	2		4	14	2	1	<u> </u>	1		1	1	12	-
}	diract		2		2		-	4	2		3 1	1.	2		,		,		3 1		*		*		<u>,</u>
	indirect		12 12					4		4	1	4	1.	<u>.</u>	1.	3	1	<u>s</u>	1.		1	3	- 14	<u>-</u>	
	dir/indir	1	14 <u>15</u> 17 17		1	7	- 1	4 6		4 6	1	*	- 1	0		<u> </u>	1	0	1	0 0	1	0	- 1.		
	direct	- 1	17 17 14 14		1	<u></u>		2		2	1	4	4		21	5	4	0 5	1	9		9	2	<u>,</u>	
12 ACH	lindiract		47	14 17		- 1			ა ი	1	ა ი	14	*	1:	2		<u>.</u>	1	5	14	4	1	5	11	5
	dir-indirect	1	, 9	7 17 9 19		- 2	<u>.</u>		8	- 1	0 A	1	,	· 2	2	- 10	9	- 1	3	14	8		4	2	, 
AIC	PVAVS	A	7	19			2			<u> </u>		13	-		<u>د</u>	- 24		- 4	∠ \0	2		2		- 23	<u>}</u>
Evan		<u> </u>	<u></u>	3 	9 4			0 -	5	°		6	2		ы П	8	,		/U	8	4	8		11	<u>_</u>
Evap.		4	ບ ວ	5	4			5	-	6	4	8	D MAN	500×	<b>4</b>		1	9	0	8	U 78/67	8	4	10	0
Cooline	PVAVS + indializion	4	, -	5	۱ ۵		• 323/35 •	<u> </u>	<u>/</u>	- 6	*	imm 92	1000	anne /	D 80996	***** ð.	3 (R)))	A 10	<u>ነዋ</u> <u>መ</u>	ANN 81		ami 9		K	5 Mg
loooning	PVAVS + ind/dir/DA	4	2	4	9	7		5	** 5	6	2	8	<u>,</u>	10	<u> </u>	- /4	•	9	∠	/	<u> </u>	8	1	10	4
	r vavo + ind/dir/KA	4	۷.	4	49 7		1	5	J	6	۷	8	r		٤		5	9	ð	8.	ι,	8	0	10	Э

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	Location											I	Nice	e FR	2										
	internal gains				1	ow ir	ntern	al qa	ins			-					hi	ah in	terna	l gain	15				
1	solar gains		low high low h				med	lium	-		hi	ah			lo	w		Í	med	lium			hi	ah	
1	Inertia	hi	ah	lo	w	hi	qh	lo	w	hi	gh	lo	w	hig	gh	lo	¥	hi	gh	lo	w	hi	gh	lo	w
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor
Maximur	n Indoor Temperatures	(C)			·	·				-								ć						-	
	direct	26	25	26	25	28	25	26	25	27	25	31	25	27	27	28	27	ॅ31	27	29	27	<b>3</b> 1	27	34	27
4 ACH	indirect	26	25	26	25	28	25	26	25	27	25	31	25	28	27	28	27	31	27	30	28	31	28	34	28
	dir/indir	25	24	26	24	28	24	26	25	27	25	830	25	27	27	28	27	31	27	29	27	30	27	333	27
	direct	24	23	25	23	27	23	25	24	26	24	28	24	26	25	26	25	28	25	27	25	28	25	30	25
8 ACH	indirect	24	24	25	24	27	24	25	24	26	24	28	24	26	25	27	25	29	25	27	26	28	26	31	26
	dir/indir	24	23	25	23	26	23	25	24	26	24	28	24	26	25	26	25	28	25	27	25	28	25	30	25
	direct	24	23	24	23	26	23	24	23	25	23	27	23	25	24	26	24	27	24	26	25	27	25	29	25
12 ACH	indirect	24	23	24	23	26	23	24	24	25	24	27	24	25	25	26	25	28	25	27	25	27	25	29	25
	dir-indirect	24	23	24	23	26	23	24	23	25	23	27	23	25	24	26	24	27	24	26	24	27	24	29	24
A/C	PVAVS	19	12	20	12	22	12	21	14	22	14	23	14	22	20	22	20	23	20	23	22	23	22	23	22
Evan	PVAVS + ind/OA	19	12	20	12	22	12	21	14	22	14	23	14	22	20	22	20	23	20	23	22	23	22	23	22
Evap. Dro-	PVAVS + ind/BA	19	12	20	12	22	12	21	14	22	14	23	14	22	20	22	20	23	20	23	22	23	22	23	22
Cooling	PVAVS + ind/dir/OA	10	12	20	12	22	12	21	14	22	14	23	14	22	20	22	20	23	20	23	22	23	22	23	22
coomig	PVAVS + ind/dir/PA	10	12	20	12	22	12	21	14	22	14	23	14	22	20	22	20	23	20	23	22	23	22	23	22
	FYRYS F IIIG/GI//KR	13	12	20	12		12		1			20					20			20	Pr 64	~		20	
Descent 1																									
Percent	nours undercooled	20126	6 4 7 4 9 7 5 8 5 10 8 5 4 7 4 9 2 1 3 1 5			11.00		Siller -		220		352 a la	15.40			100	15 A B		98° 4 15		an a		31 A D		
	direct	88 <b>6</b>	6     4     7     4     9       7     5     8     5     10       5     4     7     4     9       2     1     3     1     5       3     2     4     2     5		4	D	4	1	4	©10	4	S10	STU COO		STU Contractions		301U		影TU 第一分	-44					
4 ACH	indirect	1898	() () ()	8 N N	(%)) 1	310 300 a	888 D.	242 D	<u> ()</u> 5	888 <b>8</b>	<u>ي</u> جي	331U	<u> (3</u> 5	<u> </u>					<u>. UU</u>				354.0		
	dir/indir	Sint D	5 4 7 4 9 2 1 3 1 5 3 2 4 2 5		4	3(%) <b>0</b>	3		3	(M) 9	3	3A10	80 I U	<u> </u>	287 2010	<u></u>	i⊗10 ar≪≂	381U	◎ ② 2011	<u> </u>	\$831U 2860	2220	(10) (10) (10)		
	direct	2	1	3	1	St 5		2	1	3		38 S	1	382 G	3.0	(新語) O	1000	8	RE 5	8825 9825	8825 8825	200 D	1866 - 1866 -	8338	· 通知 -
8 ACH	indirect	3	2	4	2	30.5	2	3	2	4	2	2005 S	2	8 M 6	889.6	(語語) ·	9999 B	888	(3)% G	10% D	6865	And I.	3997 <b>5</b>	200 A	@\$\$15
	dir/indir	Z	U	3	0	4	0	2	0	3	0	4		<u>کیں</u>	4	380	4	(A).	4	3(9) C 3(9)	4	(3%) C	4	3×0	4
	direct	1	0	2	0	3		1	0	2	0	3	0	3	2		2	<u></u> 5	2	3	2	3	2	Sec. 2	2
12 ACH	indirect	2	1	2	1	4	1	2	1	2		4	1	4	3	- 4	3	<u>8</u> 6	3	4	3	4	3	30% b	3
	air-indirect	1	V	1		<u> </u>	U U	1	0			2	U A	4	2	3		4		- 2	1	3		4	1
A/C	PVAVS	0	0	0	0	0	0	0	0	<u> </u>	0	0	0	U	0	0	U	0	0	0	U	0		<u> </u>	U
Evap.	PVAVS + ind/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-	PVAVS + ind/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cooling	PVAVS + ind/dir/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
	PVAVS + ind/dir/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
					-								_							_					
Cooling	and Fan Energy Use (k	Wh/n	Vh/m2)				_			_			_								-				
	direct	_	9		9		9		9		9		9	1	0	1	0	1	0	9	)	!	9	1	0
4 ACH	indirect	1	9 9 10 11		1	0	1	0	1	0	1	1	1	2	1	2	1	2	1	1	1	1	1	2	
	dir/indir	1	10 11 13 13		1	3	-	12	1	3	1	3	1	5	1	5	1	5	1.	4	1	4	1	6	
	direct	1	13 13 12 12		1	2	-	11		1	1	2	1	3	1	3	1	3	1:	3	1	3	1	4	
8 ACH	indirect	1	14 14		1	4		13	1	4	1	5	1	6	1	6	1	7	1	5	1	6	1	8	
	dir/indir	1	17 17		1	8	4	16	1	7	1	8	2	0	2	0	2	21	1:	9	2	20	2	2	
	direct	1	13 14 16 17		1	4	-	13	1	3	1	4	1	5	1	5	1	6	1.	4	1	5	1	7	
12 ACH	indirect	1	16 17 19 20		1	17	-	16	1	6	1	7	1	9	1	9	2	20	1	8	1	9	2	2	
	dir-indirect	1	16 17 19 20		2	20	[	18	1	9	2	1	2	3	2	3	2	25	2	2	2	23	2	6	
A/C	PVAVS	4	19 20 2 49 56 1		30		54	7	'3	9	6	7	7	8	4	1	05	8	4	9	2	1	11		
Evap.	PVAVS + ind/OA	4	49         56         8           48         55         7           47         56         88		78		52	7	71	9	5	7	5	8	2	1	03	8	1	8	19	10	)8		
Pre-	PVAVS + ind/RA	4	48         55         74           47         56         38         8           46         53         74		33		64		5	<b>3</b> .1	01	8888	0	8	8	SE 1	10	8	7	9	6	<b>1</b>	16 🕷		
Cooling	PVAVS + ind/dir/OA	4	47         56         88883           46         53         76           46         54         79		76		59	e	<b>59</b>	9	2	7	3	7	'9	9	9	7	8	8	15	10	05		
	PVAVS + ind/dir/RA	4	16		54	7	79		61	7	71		7.00	7	7	8	4	飜1	05	8	3	9	н	<b>1</b> ,	11

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	Location											Ee	lde	NE	TΗ										
	internal gains				1	low ir	ntern	al ga	ns								hi	gh in	terna	ıl gair	ns		_		-
	solar gains		lo	w			med	ium	-		hi	gh			lo	w			med	lium		ł	hi	ah	
	Inertia	hig	gh	lo	Ŵ	hi	gh	lo	w	hi	gh	lo	w	hig	gh	ło	w	hi	gh	lo	w	hi	gh	lo	w
	bldg location	per	cor	per	сог	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	рег	cor	per	cor	per	cor
Maximu	m Indoor Temperatures	(C)																				-			
	direct	24	23	25	23	27	23	25	24	26	24	29	24	26	25	27	25	29	25	28	27	29	27	#32	27
4 ACH	indirect	25	23	25	23	27	23	26	24	27	24	29	24	27	26	28	26	\$30	26	29	27	\$30	27	32	27
	dir/indir	24	23	24	23	26	23	25	23	26	23	28	23	26	25	27	25	28	25	28	26	29	26	31	26
	direct	23	22	24	22	25	22	24	23	24	23	27	23	25	24	25	24	27	24	26	24	27	24	29	24
8 ACH	indirect	24	23	24	23	26	23	25	24	25	24	27	24	25	25	26	25	28	25	27	25	28	25	30	25
	dir/indir	23	22	23	22	24	22	23	22	24	22	26	22	24	23	25	23	26	23	25	24	26	24	27	24
	direct	23	22	23	22	24	22	23	22	24	22	25	22	24	23	24	23	26	23	25	24	26	24	27	24
12 ACH	indirect	24	23	24	23	25	23	24	23	25	23	27	23	25	24	25	24	27	24	26	25	27	25	28	25
	dir-indirect	22	22	23	22	24	22	23	22	23	22	25	22	23	23	24	23	25	23	24	23	25	23	26	23
A/C	PVAVS	18	10	19	10	22	11	21	12	22	12	23	13	22	20	22	20	23	20	22	21	23	21	23	21
Evap.	PVAVS + ind/OA	18	10	20	10	22	10	21	12	22	12	23	13	22	19	22	20	23	20	22	21	23	21	23	21
Pre-	PVAVS + ind/RA	18	10	20	10	22	11	21	12	22	12	23	13	22	19	22	20	23	20	22	21	23	21	23	21
Cooling	PVAVS + ind/dir/OA	18	10	20	10	22	10	21	12	22	12	23	13	22	20	22	20	23	20	22	21	23	21	23	21
	PVAVS + ind/dir/RA	18	10	20	10	22	10	21	12	22	12	23	13	22	20	22	20	23	20	22	21	23	21	23	21
				_																					
Percent	hours undercooled																						_		
	direct	0	0	1	0	3	0	1	0	1	0	3	0	5	6	<b>##6</b>	6	<b>6</b>	<b>6</b>	5	6	6	<b>8</b> 6	<b>8</b> 6	8
4 ACH	indirect	1	0	2	0	3	0	1	0	2	0	3	0	8	6	6	6	<b>3</b> 7		5	6	<b>10</b> 6	<b>M</b> 6	第7	6
	dir/indir	0	0	1	0	2	0	Õ	0	1	0	2	0	5	25	6	5	8	5	5	酬5	105	<b>5</b>	6	5
	direct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	1	0	2	0
8 ACH	indirect	0	0	0 0 0 0 1 0 0 0 0 1 0 0 0 0		1	0	0	0	0	0	1	0	1	0	1	0	2	0	1	0	1	0	2	0
	dir/indir	0	0			0	0	0	0	0	0	0	0	0	0	0	0	1	Ó	0	0	0	0	- 1	0
	direct	0	0	0 0 0 1 0 0 0 0 0 0 0 0		0	0	0	0	0	0	0	0	0	0	0	0	Ó	0	0	0	0	ō	0	
12 ACH	indirect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	ō
	dir-indirect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A/C	PVAVS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Evap.	PVAVS + ind/DA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-	PVAVS + ind/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cooling	PVAVS + ind/dir/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PVAVS + ind/dir/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cooling	and Fan Energy Use (k)	Nh/m	2)						·																
	direct	9		9	)	9		8		8		8		9		9		ġ	)	9	)	9		9	
4 ACH	indirect	9		1	0	10	0	9		9	1	9	1	10	5	1(	)	1	0	10	0	10	5	10	5
	dir/indir	12	9 10 12 12		12	2	1.	1	1	1	1	1	13	3	1:	3	1	3	1:	3	1:	3	13	3	
	direct	10	12 12 10 11		1.	1	1(	)	1	0	10	)	1	1	12	2	1	1	11	1	1'	1	11		
8 ACH	indirect	11	10 11 11 12		12	2	11	1	1	1	1	1	13	3	13	3	1	3	1:	3	1	3	13	3	
	dir/indir	14	11 12 14 14		14	4	1:	3	1:	3	14	1	16	5	16	5	1	7	1:	5	10	3	16	3	
	direct	11	14         14           11         11		12	2	11	1	1	1	11	1	12	2	12	2	1	3	12	2	12	2	12	2	
12 ACH	indirect	12	1 11 12 13		1:	3	12	2	1:	2	12	2	14	•	15	5	1	5	14	4	14		14		
	dir-indirect	18	5	1:	5	11	6	14		14	4	1!	5	17	7	18	3	1	B	17	7	17	7	17	7
AIC	PVAVS	35	5	3	9	5	5	42	2	4	8	69	)	58	3	62	2	7	7	63	3	69	,	87	
Evap.	PVAVS + ind/OA	刹網3:		3	9.46	MW 54	8.000	42	2	4	<b>B</b> (M)	Min 70	) Mile Mile Mile Mile Mile Mile Mile Mile	翻 58		63		靈7	B	<b>30</b> 64	4题	70		88	
Pre-	PVAVS + ind/RA	32	2	31	8	MM 54	8.////	4		4	9 MA	顺行:		<b>61</b>		66	<b>1</b>	8	2 100	<b>8</b> 67	7.88	7:		92	
Cooling	PVAVS + ind/dir/OA	34	1	39	9	5	5	4		4	7	69	•	57	<u> </u>	61		7	5	62	2	68	3	86	;
	PVAVS + ind/dir/RA	32	2 [	31	B	57		4		4		172	2)[[[[	<b>800</b> 60		65	- MI	<b>****</b> 8	調體	60	<b>5</b> (11)	MW 72		92	2.400

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	Location											ŀ	Kew	GE	3										
	internal gains				l	ow ir	nterna	ıl gai	ins								hi	gh int	terna	l gair	15				
	solar gains		low in low in ligh low hig		med	ium			hiç	yh			lo	w			med	lium			hi	gh			
	Inertia	hig	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w
	bldg location	per	cor	per	cor	per	cor	per	cor	per	сог	per	cor	per	cor	per	сог	per	cor	per	cor	per	cor	per	cor
Maximun	n Indoor Temperatures	(C)																							
	direct	24	23	24	23	26	23	25	23	25	23	28	23	26	26	27	26	28	26	28	26	28	26	831	26
4 ACH	indirect	24	23	25	23	26	23	25	24	26	24	28	24	26	26	27	26	29	26	28	27	29	27	31	27
	dir/indir	23	23	24	23	25	23	24	23	25	23	27	23	26	25	26	25	28	25	27	26	28	26	30	26
	direct	23	22	23	22	24	22	24	23	24	23	26	23	24	24	25	24	26	24	26	24	26	24	28	24
8 ACH	indirect	23	23	24	23	25	23	24	23	24	23	26	23	25	24	25	24	27	24	26	25	27	25	2 <del>9</del>	25
	dir/indir	22	22	23	22	24	22	23	22	23	22	25	22	24	23	24	23	25	23	25	24	25	24	27	24
	direct	23	22	23	22	24	22	23	_ 22	23	22	25	22	24	23	24	23	25	23	25	23	25	23	26	23
12 ACH	indirect	23	23	23	23	24	23	24	23	24	23	26	23	24	24	24	24	26	24	25	24	26	24	28	24
	dir-indirect	22	22	22	22	23	22	23	22	23	22	24	22	23	23	23	23	24	23	24	23	24	23	26	23
A/C	PVAVS	17	11	19	11	21	11	20	13	21	13	22	14	22	20	22	20	23	20	22	22	23	22	23	22
Evap.	PVAVS + ind/OA	17	11	19	11	21	11	20	13	21	13	22	14	22	20	22	20	23	20	22	22	23	22	23	22
Pre-	PVAVS + ind/RA	17	11	19	11	21	11	20	13	21	13	22	14	22	20	22	20	22	20	22	22	23	22	23	22
Cooling	PVAVS + ind/dir/OA	17	11	19	11	21	11	20	13	21	13	22	14	22	20	22	20	22	20	22	22	23	22	23	22
	PVAVS + ind/dir/RA	17	11	19	11	21	11	20	13	21	13	22	14	22	20	22	20	22	20	22	22	23	22	23	22
Percent	ours undercooled																								
	direct	0	7         11         19         11         21           0         0         1         0         2           0         0         1         0         2           0         0         0         0         2           0         0         0         0         2           0         0         0         0         2           0         0         0         0         0           0         0         0         0         0		0	0	0	1	0	2	0	4	飁5	5	圜5	<b>1</b> 5	5	4	驟5	5	5	15	龖5		
4 ACH	indirect	0	0 0 1 0 2 0 0 1 0 2 0 0 0 0 2 0 0 0 0 0 0		0	1	0	1	0	2	0	4	6	. 5	6	6	6	4	<b>86</b>	5	6	6	6		
1	dir/indir	0	0	0	0	2	0	0	0	0	0	2	0	3	4	4	4	5	4	3	4	4	4	5	4
	direct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0
8 ACH	indirect	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	1	0	1	0	2	0
	dir/indir	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
	direct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 ACH	indirect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	dir-indirect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A/C	PVAVS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Evap.	PVAVS + ind/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-	PVAVS + ind/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cooling	PVAVS + ind/dir/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	PVAVS + ind/dir/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cooling	and Fan Energy Use (k	Wh/m	12)																						
	direct	1	8		8		8		7		8		8	! !	9		9		8	. 8	3	-	8		3
4 ACH	indirect		9		9	1	9	1	8		8	-	8	1	0	1	0	1	0	9	9		9		9
	dir/indir	1	9 9 11 11		1	11	1	0	1	0	1	0	1	12	1	3	1	2	1	2	1	2	1	2	
	direct	1	11 11 10 10		1	10	9	9		9		9	1	10	1	1	1	0	1	0	1	0	1	0	
8 ACH	indirect	1	10 10 10 10		1	11	1	0	1	0	1	0	1	12	1	2	1	2	1	2	1	2	1	2	
	dir/indir	1	10 10 11 12 13		1	13	1	2	1	12	1	2	1	15	1	5	1	5	1	4	1	5	1	5	
	direct	1	12 13 10 10		10	1	0		0	1	0	1	11	1	1	1	11	1	1	1	1	1	1		
12 ACH	indirect	1	1	-	11	1	12	1	1	1	1	1	1	1	13	1	3	1	13	1	3	1	3	1	3
	dir-indirect	1	3	<u> </u>	4	1	14	1	3		3	1	3	1	16	1	6		6	1	5	1	5	1	6
A/C	PVAVS	3	6		10		55	4	4		50	7	0	5	59	6	3	7	76	6	i1	•	6	8	2
Evap.	PVAVS + ind/OA	3	15		39		54	4	13		19	6	59	5	58	6	52	7	75	6	iQ		5	8	1
Pre-	PVAVS + ind/RA	3	3		39		57	4	4		1	1	3		52		6		ň.	6	5	5	0	E C	7
Cooling	PVAVS + ind/dir/OA	3	33		37		51	4	10	4	16	6	65		55		58		71	5	7	[	51	7	6
	PVAVS + ind/dir/RA	3	33		38	:	55	4	12	4	19		<i>(</i> 1		60		4)		8	6	3		8	8	5

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	Location											Zu	iric	h HI	EL										
	internal gains		low i high low h			ow ir	itern	al ga	ins								hi	gh in	terna	il gair	ns				
	solar gains		lo	w			med	ium			hi	gh			lo	w			med	dium		_	hi	gh	
1	Inertia	hi	gh	io	¥	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w	hi	gh	lo	w
	bldg location	рег	cor	per	cor	рег	cor	per	cor	per	cor	per	cor	per	сог	per	cor	per	cor	per	cor	per	cor	рег	сог
Maximur	n Indoor Temperatures	(C)																		· · · ·					
	direct	28	26	29	26	31	26	29	26	₩30	26	33	26	32	31	33	31		\$31	∭33	32	34	\$32	80	32
4 ACH	indirect	29	26	30	27	32	27	30	27	31	27	34	27	\$33	32	34	\$32	35	32	\$34	\$33	35	\$33	87	33
	dir/indir	27	25	28	25	₿31	25	28	25	29	25	32	25	31	\$30	32	30	\$34	30	32	§31	\$33	231	89	\$31
	direct	26	25	27	25	29	25	27	25	27	25	29	25	28	27	29	27	31	27	29	28	\$30	28	32	28
8 ACH	indirect	27	26	28	26	30	26	28	26	29	26	31	26	30	28	31	28	\$32	28	31	29	32	29	₩33	29
	dir/indir	25	24	26	24	27	24	25	24	26	24	28	24	27	26	28	26	\$30	26	28	26	29	26	×30	26
	direct	25	24	26	24	27	24	26	24	26	24	28	24	27	26	27	26	29	26	27	26	28	26	\$30	26
12 ACH	indirect	27	26	28	26	29	26	28	26	28	26	<b>%</b> 30	26	29	28	29	28	\$31	28	\$30	28	\$30	28	32	28
	dir-indirect	24	24	25	24	26	24	24	24	25	24	26	24	26	25	26	25	27	25	26	25	26	25	28	25
A/C	PVAVS	25	25	25	25	25	25	24	25	24	25	24	24	25	26	26	26	25	26	25	25	24	25	24	25
Evan	PVAVS + ind/OA	25	25	25	25		25	24	24	24	24	24	24	25	26	25	26	25	25	24	25	24	25	24	24
Pre-	PVAVS + ind/RA	25	25	25	25	25	25	24	24	24	24	24	24	25	26	25	26	25	25	24	25	24	25	24	24
Cooling	PVAVS + ind/dic/OA	24	25	25	25	25	25	24	24	24	24	24	24	25	26	25	26	25	25	24	25	24	25	24	24
	PVAVS + ind/dir/RA	24	25	25	25	25	25	24	24	24	24	24	24	25	26	25	26	25	25	24	25	24	25	24	24
L			20			~~							2.4	20	10	2.9	20	10	2.0	<b>*</b> 71		24	2.5		24
Percent	hours undercooled																	-							
i ercent i	direct	2	2         0         4         0           3         1         5         1           2         0         3         0				0	2	4	4	4	SUM 7	4	<b>840</b>	<b>340</b>	223	12	~~~~~	1.22	×10	×10	r 781	240	777	W 10
	indiract	2	0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		2011 7 2011 7	1		. !	1	1	303 r	2		(A)	- V		2		60	861U				8.10	
	dir/indir	2		) 3 0 6 ) 1 0 2		5 F	- 1		- 4	2 /////	- 2	0 %% 2 %%	2	10	1983 6 1980 o		₩¥.0			Min.			20 (M	 	200
<b></b>	diract	-	0	5         1         7           3         0         6           1         0         2				- 0		-	3000	0	2 88/43	(699) 1	-	1 1 1 1 1 1 1	1000	A 1995	2000 3	7992		1988 B	000 8000 =	4 1/1/12	
	indirect	1	- 0	0 3 0 6 0 1 0 2 0 1 0 3		0	1			- 0	- 4	- 0			3	2	C 1999	- 1	3	י י	3		SHIE C		
	dislindis			1 0 2 1 0 3		0		0	4	0	- 3	0	4	د م	4	<u>د</u>			4		4	3	AIIII 0	3	
	diraat		0	0	0	-	0	0	0	0	0	- 1	0		0	~	0	4		2	'	4	1	4	1
12 404	direct	-		0		- 1	0		0	0	0	1	0		0	1	0	2	0		- 0	1	0	2	0
12 ACH	Indirect	U A	0	0	0	1	0	0		1		- 21	0	2	1	<u>-</u> 2		3		2	1	2	1		
	air-indirect		0		0	0	0	0	0	0	0	0	U	U	0	U		1	0	- 0		0	U	1	0
A/C	PVAVS	0	0	U	U	U	0		0	U	U		U	U	4	1	4	0	4	0	1	0	1	0	
Evap.	PVAVS + ind/OA	0	0	0	0	U	0	0	0	0	0	0	0	0	3	0	3	0	2	0	0	0	0	0	0
Pre-	PVAVS + ind/RA	0	0	0	0	0	0	0	0	0	0	- 0	0	0	4	0	4	0	3	0	0	0	0	0	0
Cooling	PVAVS + ind/dir/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	0		0	0	0
	PVAVS + ind/dir/RA	0	0		0	0	0	0	0	0	Q	0]	0	0	3	0	3	0	2	0	0	0	0	0	0
								_																	
Cooling	and Fan Energy Use (k)	Nh/m	12)			-								_				·		r					
	direct	e	5	6	5	7	<u> </u>		6	. (	<u> </u>	7	7	1	2	1:	3	1	2	1.	2	1	3	1	3
4 ACH	indirect	8	3	2	•				8	9	•	1	0	1	5	1	6	1	6	1	6	1	6	1	6
ļ	dir/indir	ş	9 10		1	1		9	1	0	1	2	1	9	2	0	2	0	2	0	2	0	2	0	
	direct	7	7 8		9	2		7	1	3	9	•	1	5	1	6	1	6	1	6	1	6	1	6	
8 ACH	indirect	1	10 11		1	2	1	0	1	1	1	3	2	0	2	1	2	!1	2	0	2	1	2	2	
	dir/indir	1	10 12		1	4	1	1	1	2	1	4	2	4	2	5	2	:6	2	4	2	6	2	6	
	direct	7	7 8 12		1	0		7	. 1	3	1	0	1	7	1	8	1	8	1	7	1	8	1	8	
12 ACH	indirect	1	8 1 12		1	4	1	1	1	2	1	4	2	3	2	4	2	4	2	3	2	4	2:	5	
	dir-indirect	1	1	1	2	1	5	1	1	1	3	1	6	2	6	2	7	2	8	2	6	2	8	2	9
A/C	PVAVS	1	9	2	1	3	0	2	2	2	5	3	7	3	5	3	8	4	6	3	8	4	2	5	4
Evap.	PVAVS + ind/OA	1	8	2	8         11         1           12         1         1           12         1         1           12         1         1           21         2         2		8	2	0	2	4	3	6	3	4	3	7	4	4	3	7	4	1	5	1
Pre-	PVAVS + ind/RA	11111	9 🛲	8         11         1           12         1         1           12         1         1           12         1         1           21         2         2           20         2         3		0 📖	制制2	2 40	2	6	3	8	MI 3	7.88	4	0	<b>2</b> .4	8	4	0	<b>1</b>	4 🗱	5	5	
Cooling	PVAVS + ind/dir/OA	1	7	1	9	2	7	1	9	2	3	3	4	3	3	3	5	4	2	3	5	3	9	4	9
	PVAVS + ind/dir/RA		9	2	19 2 22		0	11112	2.00	1111 2	5.	3	8.00	MI#3	6 ##	<b>iiiii</b> 3	9 /////		6	3	9.11	1164	3	Mil 5-	4.88

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	Location											Frai	nkfu	urt C	GER	2					· · · ·	÷			
	internal gains					ow ir	v internal gains high internal gains											ns							
	solar gains	low			medium			high			low			medium				high			-				
	Inertia	hig	ah	10	w	hie	gh	lo	w	hi	gh	lo	w	hi	gh	io	w	hi	gh	lo	w	hig	ah	lo	<b>~</b>
	bldg location	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor	per	cor
Maximur	n Indoor Temperatures	(C)				<u>.                                     </u>		•		·		<u> </u>													-
	direct	28	26	29	26	\$32	26	29	26	<b>\$</b> 30	26	\$34	26	<b>M</b> 32	赛31	\$33	31	ିଟ୍ଲ	31	₹33	\$32	\$34	32	97	32
4 ACH	Indirect	29	27	\$30	27	833	27	30	28	31	28	्रह	28	\$33	\$32	34	332	ିନ୍ତ୍ର	32	34	\$33	রন	33	ित्व	33
	dir/indir	27	25	28	25	31	25	28	25	29	25		25	11	\$30	\$32	\$30	21	30	32	30	लिं	\$30	36	31
	direct	26	25	27	25	29	25	27	25	28	25	\$20	25	28	27	29	27	्र ि.त.न	27	29	28	<u>8</u> 30	28	<b>6.</b> 22	28
A ACH	indirect	27	26	20	26	\$30	26	28	26	20	26	200 201	20	20	28	\$20	28	12	28	21	20	31	20	223	-20
	dir/indir	25	24	25	24	28	24	25	24	26	24	20	24	27	26	28	26	29	26	28	26	29	26	×21	26
	dinnidii	25	24	20	27	20	24	20	24	27	25	20	24	27	20	27	20	20	26	20	26	20	26	300 M	
42.4011	airect	25	24	20	24	21	24	20	20	21	20	20	23	- 21	20	- 21	20	29	20	20	20	20	20	200) 2017	20
	dis indirect	20	20	21	20	29	20	21	20	20	20	歌30 27	20	20	21	29	21	20	21	29	20	20	20	201	20
	air-indirect	24	24	24	24	20	24	24	24	20	24	21	24	23	20	20	20	21	20	20	25	20	20	20	23
A/C	PVAVS	25	25	25	25	25	25	24	24	24	24	24	24	25	20	25	26	25	25	24	25	24	25	24	24
Evap.	PVAVS + ind/OA	24	25	25	25	25	24	24	24	24	24	24	24	25	25	25	25	25	25	24	25	24	24	24	24
Pre-	PVAVS + ind/RA	24	25	25	25	24	24	24	24	24	24	24	24	25	25	25	25	25	25	24	24	24	24	24	24
Cooling	PVAVS + ind/dir/OA	24	24	25	24	24	24	24	24	24	24	24	24	25	25	25	25	25	25	24	24	24	24	24	_24
	PVAVS + ind/dir/RA	24	24	25	24	24	24	24	24	24	24	24	24	25	25	25	25	25	25	24	24	24	24	24	24
Percent	nours undercooled									-												( bening the second			
4 ACH	direct	3	1	4	1	8%	1	3	1	<b>8</b> 15	1	8	1	<b>§10</b>	12	92	Ľ	_94	<u>IP</u>	10	<u>_ 91</u>	Û.	90	- 343	90
	indirect	3	2	. 5	2	8 8	2	4	2	66	2	8	2	ାର୍	13	13	Æ	୍ରତ	10	_ 90	18	ાર	113	<u> </u>	13
	dir/indir	2	0	3	0	都7,	0	2	0	4	0	27	0	9	310	_ 112	10	18	10	9	10	ାମ	10	<u> </u>	10
8 ACH	direct	0	0	1	0	2	0	0	0	1	0	2	0	3	2	4	2	5	2	3	2	4	2	<b>3</b> 75	2
	indirect	1	0	1	0	3	0	1	0	2	0	3	0	4	3	题5	3	7	3	4	3	题5	3	7	3
	dir/indir	0	0	0	0	1	0	0	0	0	0	1	0	1	1	2	1	4	1	2	1	2	1	4	1
	direct	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	2	0	1	0	1	0	2	0
12 ACH	indirect	0	0	1	0	2	0	0	0	1	0	2	0	2	1	2	1	3	1	2	1	2	1	3	1
	dir-indirect	0	0	0	0	0	0	0	0	0	0	Ó	0	0	0	0	0	1	0	0	0	0	0	1	0
A/C	PVAVS	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	1	0	0	0	0	0	0
Evap.	PVAVS + ind/OA	0	0	0	0	0	0	0	0	Û	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0
Pre-	PVAVS + ind/RA	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0
Cooling	PVAVS + ind/dir/OA	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
_	PVAVS + ind/dir/RA	0	0	0	0	0	Ó	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Cooling	and Fan Energy Use (ki	Wh/m	2)																						
	direct	6	3	6	3	7	7		6		7	7	7	1	1	1	1	1	2	1	1	1	2	1	2
4 ACH	indirect	8	3	ę	)	10			8		9	10		1	4	1	4	15		1	4	1	5	15	
	dir/indir	9	•	10		1	2	9		1	0	1	2	1	8	18		19		1	8	1	9	19	
	direct	7	7	5	3	9	•		7	8		10		1	4	1	5	16		1	5	1	5	16	
8 ACH	indirect	10		11		1	3	1	0	1	1	1	3	1	9	2	0	2	!1	2	0	2	0	21	
	dir/indir	1	0	1	2	1	5	1	1	1	2	1	5	2	3	2	4	2	5	2	3	2	4	2	5
<u> </u>	direct		,	5	1	1	0		8		•	1	1		6	1	7	1	8	1	6	1	7	1	8
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#### 4 Conclusions

The tables show that the performance of evaporative cooling varies tremendously with the humidity, or more specifically, wet-bulb temperatures, for a given climate. Furthermore, because the capacity of evaporative cooling is constrained by atmospheric conditions and economically justifiable air flow rates, its applicability also depends on the amount of cooling loads that must be removed.

Tables 3, 4, 5, 9 and 15 show that in the humid summer conditions throughout the eastern part of the US and Canada (Minneapolis, New York, Washington, Chicago and Toronto), stand-alone evaporative cooling systems have minimal applicability, except possibly indirect/direct units at 12 ach in well designed buildings. Even so, the indoor temperatures will be noticeably higher than in air-conditioned buildings, and the energy savings will be small to negative. As precoolers, however, evaporative cooling can still provide energy savings, particularly when the room exhaust air is used as the secondary air. This can be considered as a way to recover the coolness from the refrigerated exhaust air.

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Tables 6 and 10 show that in the extremely humid climates of Miami and Fort Worth, evaporative cooling does not work for all building conditions. There are small energy savings for precooling with room exhaust air, but they are probably not economically justifiable.

Tables 11 and 16 show that evaporative cooling performs very well in Denver and Edmonton, which have moderately hot but dry summers. Standalone evaporative cooling systems, even direct systems, will maintain satisfactory indoor temperatures at 8 ach in all hut the most unfavourable building conditions, eg perimeter zones with high solar gains. At 12 ach, the indoor temperatures are similar to those with conventional air conditioning, but the energy savings are reduced from 30–50% to 15–30%.

Table 12 shows that in Albuquerque, which has hotter but equally dry summers as Denver, an indirect/direct evaporative cooling system at 8 ach is sufficient for buildings with low to moderate loads, but 12 ach may be needed in buildings with higher cooling loads. In both climates there are also substantial energy savings from the use of evaporative precooling.

Table 8 shows that in Los Angeles, which has a Mediterranean climate with mild but semi-humid conditions, stand-alone indirect/direct evaporative cooling at between 4 and 8 ach will maintain adequate indoor temperatures provided that the building has low to moderate amounts of solar gains. In buildings with larger cooling loads, stand-alone indirect/direct units at 12 ach are necessary. In terms of energy savings, the stand-alone units are always beneficial, but only if they are indirect/direct evaporative precooling systems.

Table 7 shows that for Phoenix, which has a very hot and dry desert climate, the cooling loads are so large that very high air fbw rates are needed to provide adequate evaporative cooling, and even then only for buildings with low cooling loads. Although Phoenix is the centre of the residential evaporative cooling market, the simulations show that for a medium-sized office building, indoor temperatures will be unacceptably high, except possibly for indirect/direct systems at 16 ach in a well built building. Even so, there are no energy savings compared with conventional air conditioning. As a precooling system, both indirect and indirect/direct systems provide moderate savings with no difference between using return or outside air as the secondary air.

For the European climates studied, evaporative cooling showed good potential in most locations because of their low cooling loads and moderate humidity during the summer, especially Trappes, Carpentras, Nice, The Netherlands, Kew and Helsinki (Tables 19 to 23 and 26). In Porto, Lisbon, Zurich and Frankfurt, evaporative cooling potentials seem limited to systems with 8 ach or more in well built buildings with low cooling loads. There is very little energy savings benefits from evaporative precooling in any of the European climates studied.

#### Acknowledgements

I would like to thank Mr Jean-Robert Millet, CSTB, France, for his study on evaporative cooling that provided me with insights for this study. I would also like to express my appreciation to the following colleagues who have provided me with weather data for European locations: Prof Eduardo Maldanado, University of Porto, Portugal, Mr Jon Hand, University of Strathelyde, UK, Mr Mark Zimmermann, EMPA, Duebendorf, Switzerland, Mr Matthieu Orphelin, Ecole des Mines, Paris, France, and Mr Risto Kosonen, VTT, Helsinki, Finland.

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## Chapter B

# Evaporative cooling in office buildings

Developed	by:			
Name:	J R Mi	llet		
Organisatio	n: CSTB			
Address:	>BP.02	-F-77421		
	Marn	e-la-Vallée	e Cede)	<b>(</b> 02)
	France			
Phone:	3301	6468830	U	
Fax.	millet@	0400033 Josth fr	0	
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#### 1 Introduction

For evaporative cooling, evaporation of water is used to decrease the dry-bulb temperature of air. Wetted-pad media or water sprays may be used for evaporation of the water. There are two main categories of evaporative cooling: direct and indirect.

For direct evaporative cooling, water is evaporated directly in the supply air stream, reducing the air stream's dry-bulb temperature, but increasing its absolute humidity.

For indirect evaporative cooling, two air streams are used. A secondary (or scavenger) air stream of outdoor air or exhaust air (see Figure 1) is cooled by evaporation and then exhausted. This cooler moist secondary air stream is then used to cool the primary supply air stream indirectly tbrough an air-to-air heat exchanger (which can also be used to pre-heat outdoor air in winter).

- Six different systems are considered:
- 1 No evaporative cooling night cooling only
- 2 Direct evaporative cooling
- 3 Indirect evaporative cooling
- 4 Direct + indirect evaporative cooling
- 5 No night cooling + cooling coil
- 6 Indirect evaporative cooling + cooling coil

The plant configuration is illustrated in Figure 1.

This tool for evaporative cooling in office buildings gives the maximum internal temperatures under summer design conditions for the first four systems listed above and the cooling coil load for the other two systems, which have mechanical cooling. Annual energy (heating, cooling and fan) and



Figure 1 Plant configuration

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water consumptions per annum are also provided. The values have been generated using the simplified thermal model COMET where the room behaviour is represented by an RC (resistance–capacitance) network.

The parameters of climate, building design (thermal inertia, window solar protection and internal gains) and plant are defined in the next section. The results from the simulations are presented in the form of design tables in Section 3.

#### 2 Parameters

#### 2.1 Climate

Three climatic areas are considered: centre of France (Trappes), south inland (Carpentras), and south near the Mediterranean coast (Nice).



#### 2.1.1 Temperature and humidity

2.1.2 Solar



#### 2.2 Building design

The basic information is the expected maximum operative temperature in summer, depending on the building design. Two cases are defined on the next page for inertia, solar gains and internal gains. Building design is classified as good or bad on the basis of these factors as defined in the following table.

	Building d	Building design				
	Good	Bad				
Inertia	High	Low				
Solar gains index: window solar factor × window area/floor area	0.05	0.15				
Internal gains (W/m <sup>2</sup> during occupancy)	10	30				

Interpretation of each of these parameters is discussed below. Results are only provided for east and west orientations.

#### 2.2.1 Thermal inertia

Low means one ceiling or floor of high inertia. High means ceiling, floor and side walls all of high inertia.

#### 2.2.2 Window solar protection

The ratio S×Ab/Al is defined where:

- S = window solar factor
- Ab = window area
- Al = room area

The two reference ratio values used are 0.05 and 0.15.

#### 2.2.3 Internal loads

Occupants, equipment and lighting: 10 and 30 W/m<sup>2</sup> (radiant fraction: 0.5).



#### 2.3 Plant

#### 2.3.1 Air flow

Four maximum air flow rates have been considered corresponding to 2, 4, 6 and 8 air changes per hour.

#### 2.3.2 Systems

#### Without cooling plant

- No evaporative cooling night cooling only
- Direct evaporative system
- Indirect evaporative system
- Direct + indirect evaporative system

#### With cooling plant

- No night cooling + cooling coil
- Indirect evaporative system + cooling coil

For all systems, 'night cooling' is used if of benefit.

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#### 2.3.3 Control

For each system, except where specifically excluded, 24-hour control matrices have been defined for summer and for winter conditions. Descriptions of the control matrices are provided in the IEA Annex 28 Subtask 2 Report 3 *Detailed design tools for low energy cooling technologies.* 

For annual simulations it is necessary to define transitions between winter control matrix and summer control matrix. When the calculation is done with winter control matrix, the indoor air temperature between 07.00 h and 08.00 h is checked. If this temperature is higher than 23 °C, the transition with summer control matrix is made. When the calculation is done with summer control matrix, the indoor air temperature between 08.00 h and 09.00 h is checked. If this temperature is lower than 19 °C, the transition with winter control matrix is made.

#### 3 Design tables

Two sets of simulations have been undertaken for the three different sites (Trappes, Carpentras, Nice).

The first set is related to sizing and is based on a reference warm day. In this case the outputs are the indoor temperature and required cooling power if a cooling coil is used.

The second set of runs is for a typical year, for which the outputs are the heating, cooling and fan electrical energy consumptions and water consumption.

#### Key to tables

Maximum operative temperature during occupancy for the reference warm day:

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> 26 °C and $< 30$ °C	boxes left white																			
≥30 °C and <33 °C	boxes with medium shading																			
≥33 °C	boxes with dark shading, and no numbers																			
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# 3.1 Results for a reference warm day

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	6	ind.+Cool. p	lant	24	24	24	25	24	25	25	26	25	26	27	29	26	27	29	31	24	26	31
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2	ind.+Cool. plant	<u></u> 14)	<u>%14</u> %	15	15	15	15	<b>%16%</b>	<b>%16</b>	<b>17</b>	00000					199 F.	** .×*	<b>%14</b> %	¥17.8	
vol/h	cool.plant only	<b>%19%</b>	<b>≋19</b> ∦	21	22	23	23	¥23		<u>\$</u> 23	Sec.							19		
4	ind.+Cool. plant	<u>\$</u> 20	<u></u> 238	<u></u> 26	<i>*</i> 27 <i>*</i>	¥27&	27	29	29	<b>828</b>	28	₹30∦	\$31	30	30	∦32∎		20	28	
vol/h	cool.plant only	<u>%</u> 30%	∦35∦	<b>⊗36</b> ≦	<u>%</u> 37,∦	<b>∦37</b> ∭	37.	41	44	39	41	<u>846</u>	<b>《46</b> 》	46	<b>*46</b>	<u> </u> 46\$		<b>⊗30</b> <i>⊗</i>	41	
6	Ind.+Cool. plant	21	¥25	<u>8278</u>	<u>%35</u> %	<u>%34</u>	<u>839</u>	40	<b>%4</b> 1%	<u>840</u>	<b>41</b>	. 42	44	×42	42	44	46	<u>@</u> 21∭	\$382	<b>《46</b> 》
vol/h	cool.plant only	×34×	<u>%</u> 39%	×42×	§53§	<u>%52</u> %	≬53∦	∦55∦	57	<u> </u>	<b>∦55</b> ∦	65	<b>66</b> %	58	62	§69)	<u>%</u> 69%	<b>⊘34</b> ≋	55	¥69§
8	ind.+Cool. plant	×22×	¥26 X	<u>828</u>	<u>%</u> 36%	<u>%35</u>	<u>840</u>	×41×	<u>\$53</u>	<u>42</u>	<u>%</u> 51%	53	56	53	\$54%	56	58	≪22.:		58
vol/h	cool.plant only	<b>∦37</b> ∦	<b>∦42</b> ≬	¥45 X	×56×	<b>%56%</b>	×61	<u>≬</u> 63≬	<b>%72</b> ≬	<b>≪66</b> ≬	<b>\$7,1</b> 3	77	83	73	74	87	918	37	66	<b>91</b>
	min	<u>%14</u> %	<u>14</u>	×15×	<u>%</u> 15)	<u></u> 15	<b>15</b>	<u>%16</u>	<u></u> <u>16</u>	<u>17</u>	<b>%17</b> <i>∰</i>	18	18	<b>\$18</b>	<b>⊛18</b> §	19	21	<b>&amp;14</b>		1,
(IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	AVA MINIMUM AVA	<b>∦25</b> ∦	<b>%28</b> %	<b>⊗30</b> ⊗	☆35☆	⊗35%	⊗37∛	1 39	42	39	41	×44 8	<b>≪46</b> ⊗	43	×44 ×	847.8	Sec. 8. 18	22014826	39	1

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# 3.2 Results for a reference year

Solar gains 5*Aglaz/Aroom         0.05         110 bits to gath 111 minute         0.15           Int gain wim <sup>2</sup> (8h to 18h)         10         30         10         30           Int gain wim <sup>2</sup> (8h to 18h)         E         W         E	Reterenc	e year : Trappes	-5				1	Heat	lina	nee	de (	kWh	/m2	•							
Int gain w/m² (8h to 18h)         10         30         10	Solar gai	ns S*Aglaz/Aroom				0.	05	164	uiiM	nçq				0.	15						
Inertia         High         Low         High         Low         High         Low         High         Low         High         Low           Ar flow         Exp system         Without cooling plant         min         Ave         min         Ave         min           2         direct         34         35         35         132         121         100	Int. gain	w/m² (8h to 18h)		1	0		1	3	0			1	0		Ī	3	30				
Orientation         E         W         E <th< td=""><td></td><td>Inertia</td><td><b>і</b> ні</td><td>nh</td><td>Ĩ</td><td>Ŵ</td><td>Н</td><td>ah -</td><td></td><td>w</td><td>Hi</td><td>ah</td><td></td><td>w</td><td>Н</td><td>ah</td><td>L</td><td>ow</td><td></td><td></td><td></td></th<>		Inertia	<b>і</b> ні	nh	Ĩ	Ŵ	Н	ah -		w	Hi	ah		w	Н	ah	L	ow			
Air flow       Even p.ystem       Image: biological plant       Image: biological plant <thimage: biological="" plant<="" th="">       Image: biologi</thimage:>		Drientation	F	<u>gri</u> IW	F	W	F	W	F	lw	F	Ŵ	F	lw	F	Ŵ	F	ĪW.			
1         1	Airflow	Evan system			<b>_</b>	**	-	 \	Nitho			Inlan	nt .		-		-		min	Δνe	max
2       diract       (34)       35       34)       35       112       1	AITIOW		12/1	5261	12.48							7101			( <sup>11</sup>	1	1	1		746	Inaz
2       0000       0.3       0.3       0.3       0.4       0.	2	diroct	24	25	34	25	14.91	14.28				┝╍╍┥	<u> </u>						6		╞══
Wolfn         Intercet indirect         33         1 23         2 23         2 23         2 23         2 23         2 23         2 23         2 23         2 24         2 26         1 23         1 23         2 23         2 24         2 25         1 23         2 23         2 23         2 24         2 25         2 23         2 24         2 25         2 23         2 24         2 25         2 23	2 101/15	indiraat	24	35	104	1201	64.21	64.23		<u></u>		┝━┥	┝╼╼┥		<u> </u>				6		
Indect function       33       33       34       33       12 </td <td>V01/11</td> <td>directiedirect</td> <td>34</td> <td>20</td> <td>24</td> <td>25</td> <td>12</td> <td>12</td> <td>14.68</td> <td></td> <td>1201</td> <td>┝━━┥</td> <td><u> </u></td> <td></td> <td></td> <td> </td> <td> </td> <td></td> <td>6</td> <td>1401</td> <td></td>	V01/11	directiedirect	34	20	24	25	12	12	14.68		1201	┝━━┥	<u> </u>						6	1401	
4       direct       40       40       41       14       14       120       120       123       24       126       17       88       17       23         wohn       indirect       40       40       41       14       14       14       120       123			40	10	54	2449	14	12	10		1221	<u> </u>		i	h	 			0		
4       0 Hb       40       41       14       14       120       120       123       120       123 <td></td> <td>none</td> <td>40</td> <td>40</td> <td>4.13</td> <td>41</td> <td>14</td> <td>44</td> <td>20</td> <td>1207</td> <td>23</td> <td>24</td> <td>1261</td> <td>ļ</td> <td>5</td> <td>-0-</td> <td></td> <td></td> <td>0 7</td> <td>22</td> <td>-</td>		none	40	40	4.13	41	14	44	20	1207	23	24	1261	ļ	5	-0-			0 7	22	-
volm       indirect       40       41       14       14       14       14       14       14       120	4	uirect	40	40	41	41	14	14	20	201	20	24	720	,	<u> </u>	0	ļ			23	<u> </u>
altect+indirect       40       41       41       41       14       120       20       20       20       7       100       1143       7       23         6       direct       40       40       41       41       14       20       21       23       24       27       77       8       143       7       23         6       direct+indirect       40       41       41       14       20       21       23       24       26       127       7       8       143       17       23       4         7       7       8       14       14       14       14       120       21       23       24       26       127       7       8       14       141       7       23       4       27       7       8       14       141       7       23       4       27       77       8       14       141       7       23       4       27       77       7       8       14       141       14       141       21       21       23       24       27       27       7       8       14       141       14       21       21       23	voi/n	indirect	40	40	41	41	14	14	20	20	23	24	26	1061	7				<u>'</u>	23	
6       direct       40       41       41       14       12       14	-	airect+inairect	40	40	41	41	14	14	20	20	23	24	20	201	1	8	113			23	
6       direct       40       40       41       41       14       12       12       124       1274       7       8       143       7       23         wol/n       direct+indirect       40       40       41       41       14       12       120       121       23       24       26       127       7       8       14       14       14       14       14       14       120       21       23       24       26       127       7       8       14       14       14       14       15       121       23       24       27       7       8       14       14       14       14       14       14       121       23       24       27       7       8       14       143       7       23       24       27       7       8       14       143       7       23       14       14       14       14       12       12       23       24       27       7       8       14       143       7       23       14       14       14       12       12       12       12       12       12       12       12       12       12       12       1		none	40	41	[4]	[41]	14	112			231	24							8	224	-
vol/h         indirect         40         40         41         41         14         14         12	6	direct	40	40	41	41	14	14	20	21	23	24	27	27		8	114)		7	23	
direct: indirect       40       40       41       14       14       14       12       23       24       26       277       7       8       14       14       14       14       15       123       123       123       123       123       123       123       123       123       123       123       123       123       123       123       123       123       124       27       7       8       14 <td>vol/h</td> <td>indirect</td> <td>40</td> <td>40</td> <td>41</td> <td>41</td> <td>14</td> <td>14</td> <td>20</td> <td>21</td> <td>23</td> <td>24</td> <td>26</td> <td></td> <td>ΓV.</td> <td>[[[8]]</td> <td></td> <td></td> <td>7</td> <td>23</td> <td></td>	vol/h	indirect	40	40	41	41	14	14	20	21	23	24	26		ΓV.	[[[8]]			7	23	
none         40         41         [45] [24]         [25] [24]         [25] [24]         [25] [24]         [25] [24]         [26] [27]         [7] [8]         [14] [14]         [14] [14]         [14] [14] [14]         [12] [21] [23] [24]         [27] [7] [8]         [14] [14]         [16] [16] [16] [16] [16] [16] [16] [16]		direct+indirect	40	40	41	41	14	14	20	21	23	24	26	27	7	8	14	13	7	23	41
8       direct       40       40       41       14       15       21       21       23       24       27       7       8       14       143       7       24       24       27       7       8       14       143       7       24       24       27       7       8       14       143       7       23       24       27       7       8       14       143       7       23       24       27       27       7       8       14       143       7       23       24       27       27       7       8       14       143       7       23       24       27       27       7       8       14       143       14       14       14       14       14       14       14       14       14       14       14       14       14       14       14       14       14       12		none	40	41	[4.1]	[4.1]	14	[15]	21		23	24			8	(9)			8	24	
vol/h       indirect       40       40       41       41       14       14       21       21       23       24       27       7       8       14       114       17       23       14         direct+indirect       40       40       41       14       14       21       23       24       27       7       7       8       14       141       17       23       14       141       17       23       14       141       17       23       14       141       17       23       14       141       17       23       14       141       17       23       14       141       14       14       21       21       13       14       149       123       133       17       23 </td <td>8</td> <td>direct</td> <td>40</td> <td>40</td> <td>41</td> <td>41</td> <td>14</td> <td>15</td> <td>21</td> <td>21</td> <td>23</td> <td>24</td> <td>27</td> <td>27</td> <td>7</td> <td>8</td> <td>14</td> <td>1.11</td> <td>7</td> <td>24</td> <td>41</td>	8	direct	40	40	41	41	14	15	21	21	23	24	27	27	7	8	14	1.11	7	24	41
direct+indirect         40         41         41         14         14         21         23         24         27         7         8         14         141         7         23         14         141         17         23         14         17         23         14         141 <t< td=""><td>vol/h</td><td>indirect</td><td>40</td><td>40</td><td>41</td><td>41</td><td>14</td><td>14</td><td>21</td><td>21</td><td>23</td><td>24</td><td>27</td><td>27</td><td>7</td><td>8</td><td>14</td><td></td><td>7</td><td>23</td><td></td></t<>	vol/h	indirect	40	40	41	41	14	14	21	21	23	24	27	27	7	8	14		7	23	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		direct+indirect	40	40	41	41	14	14	21	21	23	24	27	27	7	8	14	11.41	7	23	41
Ave         39         39         40         13         14         19         120         23         123		min	34	35	34	35	12	12	16	16	20	20	22	22	6	6	11	[10]	6		
Air flow       Evap.system       With cooling plant       min       Ave       Min		Ave	39	39	39	40	13	14	[1,9]	20]	23	23	25		7	7				22	
Air flow       Evap system       with cooling plant       with cooling plant       min       Ave		max	7401	[4.1]	(4.11																
2       ind +Cool plant       34       35       34       35       12       12       116       117       120       120       122       120       <	Air flow	Evap.system							With	1 000	oling p	olant							min	Ave	max
vol/h       cool.plant only       34       34       34       11       11       161       161       191       120	2	ind.+Cool. plant	34	35	34	35	12	12	16	17	201	201	22						6	-19	
4       ind.+Cool.plant       40       40       41       14       14       20       20       23       24       26       126       7       8       143       7       23         6       ind.+Cool.plant       40       40       41       41       14       120       21       23       26       126       7       7       133       7       23       14         6       ind.+Cool.plant       40       40       41       41       14       120       21       23       24       26       7       7       8       14       143       7       23       14         8       ind.+Cool.plant       40       40       41       41       13       13       20       21       23       23       26       26       7       7       14       143       7       23       44       14       14       14       14       14       14       14       14       14       14       14       17       23       23       26       26       7       7       14       14       7       23       44       14       14       14       14       14       14       14	vol/h	cool.plant only	34	34	34	34	11	11	16	[16]	191	201							5	19	
vol/h       cool.plant only       39       39       41       41       13       13       20       20       23       23       26       126       7       7       133       7       23       14         6       ind.+Cool.plant       40       40       41       41       13       13       20       21       23       23       26       26       7       7       14       143       7       23       14         6       ind.+Cool.plant only       39       39       41       41       13       13       20       21       23       24       26       27       7       8       14       14       7       23       14         8       ind.+Cool.plant       40       40       41       13       13       20       21       23       23       26       26       7       7       14       14       7       23       4         wol/h       cool.plant only       39       39       40       13       13       19       20       21       22       5       6       10       10       5       22       23       25       125       7       14       14	4	ind.+Cool. plant	40	40	41	41	14	14	20	20	23	24	26	26	7	8	14		7	23	
6       ind.+Cool. plant       40       41       41       14       14       20       21       23       24       26       27       7       8       14       141       7       23       14         8       ind.+Cool.plant only       39       39       41       41       13       13       20       21       23       23       26       26       7       7       14       141       7       23       14         8       ind.+Cool.plant       40       40       41       41       14       12       21       23       24       27       7       8       14       14       7       23       4         vol/h       cool.plant only       39       39       41       41       13       13       20       21       23       26       26       7       7       14       14       7       23       4         wol/h       34       34       34       14       14       14       14       121       22       23       25       155       7       7       13       14       14       14       14       14       14       14       14       14	vol/h	cool.plant only	39	39	41	41	13	13	20	20	23	23	26	1261	7	7	113		7	23	
vol/h       cool.plant only       39       39       41       41       13       13       20       21       23       26       26       7       7       14       143       7       23       14         8       ind.+Cool.plant       40       40       41       41       14       14       21       21       23       24       27       7       8       14       14       7       23       4         wol/h       cool.plant only       39       39       41       41       13       13       20       21       23       26       26       7       7       14       14       7       23       4         wol/h       cool.plant only       39       39       41       41       13       13       20       21       23       25       26       7       7       14       14       7       23       4         wol/h       cool.plant only       38       38       39       40       13       19       20       22       23       25       15       17       14       14       7       23       4         10       4       40       40       41	6	ind.+Cool. plant	40	40	41	41	14	14	20	21	23	24	26	27	7	8	14	14	7	23	41
8       ind.+Cool. plant       40       40       41       41       14       14       21       23       24       27       7       8       14       14       7       23       4         vol/h       cool.plant only       39       39       41       41       13       13       20       21       23       23       26       26       7       7       14       14       7       23       4         min       34       34       34       34       11       11       16       19       20       21       22       5       6       10       10       5         Ave       38       38       39       40       13       13       19       20       22       23       25       17       7       14       14       7       23       4         Ave       38       38       39       40       13       13       19       20       22       23       25       15       7       7       14       14       7       23       4         1       14       14       14       14       14       14       16       15       16 <td< td=""><td>vol/h</td><td>cool.plant only</td><td>39</td><td>39</td><td>41</td><td>41</td><td>13</td><td>13</td><td>20</td><td>21</td><td>23</td><td>23</td><td>26</td><td>26</td><td>7</td><td>7</td><td>14</td><td>[13]</td><td>7</td><td>23</td><td>41</td></td<>	vol/h	cool.plant only	39	39	41	41	13	13	20	21	23	23	26	26	7	7	14	[13]	7	23	41
vol/h       cool.plant only       39       39       41       41       13       13       20       21       23       23       26       26       7       7       14       14       7       23       4         min       34       34       34       34       34       11       11       16       16       19       20       21       22       5       6       10       10       5         Ave       38       38       39       40       13       13       19       20       22       23       25       125       7       7       14       14       7       23       4         Max       40       40       41       41       14       14       121       123       123       1241       13       10       5       133       10       5       133       10       5       143       16       153       123       1241       133       14       14       14       151       153       153       153       153       153       153       153       153       153       153       153       153       153       153       153       153       153	8	ind.+Cool. plant	40	40	41	41	14	14	21	21	23	24	27	27	7	8	14	14	7	23	41
min       34       34       34       34       34       34       11       11       16       16       19       20       21       22       5       6       10       10       5         Ave       38       38       39       40       13       13       19       20       22       23       25       125i       7       7       113i       22       22         1       max       40       40       41       41       14       14       121i       123i       13i	vol/h	cool.plant only	39	39	41	41	13	13	20	21	23	23	26	26	7	7	14	14	7	23	41
Ave       38       38       39       40       13       13       19       20       22       23       25       125       7       7       133       133       22         i       max       40       40       41       41       14       14       1211       1231       1231       1231       1231       1231       133		min	34	34	34	34	11	11	16	16	19	20	21	22	5	6	10	10	5		·
I max       40       40       41       41       14       14       14       121       123 <td></td> <td>Ave</td> <td>38</td> <td>38</td> <td>39</td> <td>40</td> <td>13</td> <td>13</td> <td>19</td> <td>20</td> <td>22</td> <td>23</td> <td>25</td> <td>1251</td> <td>7</td> <td>7</td> <td>113</td> <td></td> <td></td> <td>22</td> <td>1</td>		Ave	38	38	39	40	13	13	19	20	22	23	25	1251	7	7	113			22	1
Cooling needs (kWh/m2)         Air flow       Evap.system       with cooling plant       min       Ave       min       fill       fill </td <td></td> <td>t 🔹 max</td> <td>40</td> <td>40</td> <td>41</td> <td>41</td> <td>14</td> <td>14</td> <td>21</td> <td>121</td> <td>1231</td> <td>241</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>·</td> <td></td>		t 🔹 max	40	40	41	41	14	14	21	121	1231	241								·	
Air flow         Evap.system         With cooling plant         min         Ave         Ave         Ave	1	*	<b>.</b>	<b>4</b>	<b></b>		<b></b>		<u></u>			L.\A/L									
2       ind.+Cool. plant       2       2       4       4       8       8       121       11       163       153	Air flow	Evap.system						<u>00</u>	ung Witl	nee h coo	oling p	plant							min	Ave	max
vol/h       cool.plant only       % 6       5       9       8       14       13       [15]       [15]       [15]       [12]       [19]       10       11       10       10       10       10       10       10       11       8       7       18       17       16       15       28       260       1       11       12       10       10       10       16       16       21       20       27       25       33       31       38       36       42       7400       6       24       74	2	ind.+Cool. plant	2	2	4	4	8	8	[12]	6.0	[16]	15	[18]						2	12	
4       ind+Cool.plant       1       1       3       4       5       5       12       12       11       10       20       18       20       19       128       1       12       12       11       10       20       18       20       19       128       1       12       12       11       10       20       18       20       19       128       1       12       12       11       10       20       19       128       1       12       12       11       10       20       19       128       20       19       128       20       19       128       20       19       128       20       19       128       10       11       10       10       16       15       20       19       127       25       33       13       138       16       21       11       12       11       12       11       12       11       11       12       11       11       12       11       11       12       12       12       12       12       12       12       12       12       12       12       12       12       12       12       12       12       12 <td>vol/h</td> <td>cool.plant only</td> <td>6</td> <td>5</td> <td>9</td> <td>8</td> <td>14</td> <td>13</td> <td>15</td> <td>1151</td> <td>1201</td> <td>1191</td> <td></td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td>5</td> <td>316</td> <td></td>	vol/h	cool.plant only	6	5	9	8	14	13	15	1151	1201	1191				1			5	316	
vol/h       cool.plant only       6       6       10       9       16       15       20       19       26       24       29       127/       35       33       1351       6       21         6       ind.+Cool.plant       1       1       3       3       4       4       10       11       8       7       18       17       16       15       28       26)       1       11       12         vol/h       cool.plant only       7       6       10       10       16       16       21       20       27       25       33       31       38       36       42       240)       6       24       24         8       ind.+Cool.plant       1       1       3       3       3       9       10       6       6       16       13       13       26       25       1       10       2         8       ind.+Cool.plant       -1       1       3       3       3       9       10       6       6       16       16       13       13       26       25       1       10       2         9       i/h       cool.plant only       7	4	ind.+Cool. plant	1	1	3	4	5	- 5	12	12	11	10	20	L18	20	19	28		1	12	
6       ind.+Cool.plant       1       1       3       3       4       4       10       11       8       7       18       17       16       15       28       261       1       11       12         vol/h       cool.plant only       7       6       10       10       16       16       21       20       27       25       33       31       38       36       42       2401       6       24       24       24         8       ind.+Cool.plant       -1       1       3       3       3       9       10       6       6       16       13       13       26       25       1       10       2         wol/h       cool.plant only       7       7       10       10       16       16       21       27       25       33       33       39       37       45       44       7       25       4         wol/h       cool.plant only       7       7       10       10       16       16       21       27       25       33       33       39       37       45       44       7       25       4         min       1       1<	vol/h	cool.plant only	6	6	10	9	16	15	20	19	26	24	29	27	35	33	135		6	21	
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8       ind.+Cool.plant       -1       1       3       3       3       9       10       6       6       16       13       13       26       25       1       10       2         vol/h       cool.plant only       7       7       10       10       16       16       21       21       27       25       33       39       37       45       44       7       25       4         min       1       1       3       3       3       9       10       6       6       16       16       13       13       22       20       1         Ave       4       4       7       7       10       10       15       15       18       16       23       122       26       24       131       14       7       16         max       7       7       10       10       16       15       15       18       16       23       122       26       24       131       14       16	vol/h	cool.plant only	. 7	6	10	10	16	16	21	20	27	25	33	31	38	36	42	1401	6	24	242
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  | 23   | 24  | in a second  | 30   | 29   |  
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| VU/II  | direct+indirect  | ×17*  | 21/c   | 10  
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  | 208  
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  | ×27×   | 28  | 27   | 35   | 34   | ×37×   
   | لاند ساندا (<br>۱  | 15  | 25  |            |
| vol/h  | indirect   | 19  | <b>%19</b>   | 20  
   | 19  | 26  
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  | 33   | 34%   | × • • • •  | 8418   | VAN*   | 201X   
   |                    | 19  | 30  | +          |
|  | direct+indirect  | ×17.  | <u></u>  | <u></u> 18«   
   | \$17.   | ×23×  
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  | 26 🕅  | 26   
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  | 32   | 33  | 32   | 41   | 40   | 43   
   | 41                 | 18  | 29  | 82         |
| vol/h  | indirect   | <u></u> %23   | 23   | 24  
   | 23  | <b>∦31</b> ∦  
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  | 39   | 40  | 38   | 49   | 48   | ×49  
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|  | direct+indirect  | »20»  | <u>⊗</u> 20⊗   | [\$21   
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   | ×43                | 20  | 32  | <i>«</i> 4 |
| a the second   | 🤉 🦓 🦓 🖓  | <b>%1</b> 1 <i>%</i>  | <b>@1,1</b> .3   | <b>\$13</b> %   
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  | <b>∝15</b> ∦  | <u>.</u> 15§   
   | <b>%18</b>  
  | " <b>18</b> «  | 18  | 17   | 22   | 22   | 21   
   | <b>20</b>          | 10  |   |            |
| n al Chier   |  | <b>%17</b> <i>@</i>   | <b>%17</b> @   | 17  
   | 16  | 23  
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  | <b>≬28</b> ≬   | §29§  | 1111111  | ∦35≬   | 834  |  
   | 2.05               | 19<br>17 1  | 26  | (          |
| A:   | max 👔  | <b>%26</b> %  | ×26×   | 28  
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| ANT TIOW   | Evap.system  | ×10×  | N.4 5 W  | 1 xw # : # xw   
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   | ling p  
  | lant   |   | in the second  |  |  |  
   |                    | min   | Ave   | m          |
| ∠<br>vol/b   | mo.+Cool plant only  | (※)Z ※<br>(※)フ ※  | 381Z #   | M 141 //  
   |   | 10  
  | 10   
  | <u>8138</u>   | M15 M  
   | 18»   
  | 818 ×  | %18%  | 8 . N  | 800 ·  |  |  
   | ľ.                 | <u>811</u>  | <b>16</b>   |            |
| 4  | ind +Cool plant  | 367<br>315.8  | ».15×  | ×15   
   | 0   | 8.10 ×  
  | 810×   
  | 343<br>200  | 10   
   | \$758<br>\$26*  
  | \$158<br>258   | 24  | S 22 S   | 21   | 20   | 20.8   
   | 11                 | 8.7   | 18138   | i l        |
| vol/h  | cool plant only  | 1119.00   | 80. Q. 49  | <u>810</u> *  
   | 10×10×  | %13/  
  | M13/   
  | 15  | 14   
   | <u>%20</u> %  
  | 17   | 24  | §238   | 22   | 21   | 8 JU 8   
   | Strip-dr. 1        | <u>814</u>  | 16  |            |
| 6  | ind.+Cool. plant   | 18  | 18   | ×18×  
   | >17   | 24  
  | 23   
  | 24  | 233  
   | 831.5   
  | .31  | 300   | 28   | 38   | 37   | 37   
   | \$35               | .17   | 27  |            |
| vol/h  | cool.plant only  | <b>%1.1</b> #   | <b>%1.1</b> %  | 12  
   | 12  | <u>*14</u>  
  | <u>%</u> 14%   
  | ×18×  | ×17.   
   | ×20×  
  | ¥20×   | 22  | 21   | \$26¥  | 25   | 29   
   | 28                 | \$11c   | 19  | 100        |
| 8  | ind.+Cool. plant   | 22  | §22§   | \$21  
   | 21  | 28  
  | 28   
  | ×29   | ×28 s  
   | §37   
  | 36   | * 35×   | 34   | 845  | 44   | 44   
   | 42                 | 21  | 32  | 4          |
| vol/h  | cool.plant only  | <b>≋13</b> ∖  | <u>%13</u>   | <u></u> 14  
   | ×14%  | ×18 (   
  | <b>%18</b>   
  | 3218  | ×21.   
   | ×25   
  | 24   | 26  | 25   | 31   | . 30   | 34   
   | 33                 | 13  | 23  |            |
| ALL DESCRIPTION  | Millia Min Millia  | 20 <b>7</b> /05   | M7.M   | <b>8</b>  
   | <b>8</b> %  | <u>_11</u>  
  | <u>%1,1</u> %  
  | <b>%12</b> %  | <b>%12</b> %   
   | <u>%</u> 15%  
  | <u>%</u> 15%   | <b>%14</b> %  | 14   | <u>%</u> 19 <i>%</i>   | <b>≋19</b> ∦   | §18  
   | 18                 | <b>⊚7</b> , ∑   |   |            |
| A Suchatika  | Ave Ave  | ×13%  | <u>%</u> 13%   | <b>%14</b> %  
   | <b>≋13</b> ≬  | <b>18</b>   
  | <b>%18</b>   
  | 19  | 19   
   | 24  
  | 23   | 23  | <u></u> 22   | 29   | 29   | §30 X  
   |                    |   | 21  | ר          |
| A Bulling St.  | max 🦾  | ×22 ×   | <b>*22</b>   | \$21  
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| urd Crist  | a ware a straight  | 1. Oan a  | an An  | eath:   
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  | <u>l/m2</u>  | )<br>   | <u>.</u>   |  |  | ·# ·   
   |                    |   |   |            |
|  | Evap.system  |   |  | <u></u>   
   | Januarita   | Connection of   
  |  
  | wate<br>With  | r ne<br>out co   
   | eds (<br>poling   
  | l/m2<br>plant  | )<br>()   |  |  |  | 1  
   | <u>k</u>           | min   | Ave   | m          |
| 2  | Evap.system<br>none  |   | <b>0</b>   | <b>0</b>  
   | q   |   
  |  
  | wate<br>With  | r ner  
   | eds (<br>oling  
  | l/m2<br>plant  |   |  |  |  |  
   |                    | (min<br>∭0∭   | Ave   | m          |
| 2<br>vol/h   | Evap.system<br>none<br>direct<br>indirect  | <b>0</b>  | <b>0</b><br>88   | 0))<br>11   
   | 9   | 14  
  | 14   
  | wate<br>With  | r ner  
   | eds (<br>oling  
  | l/m2<br>plant  |   |  |  |  |  
   |                    | (min<br>(%0)))<br>(%8)  | Ave   | m          |
| 2<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect   | <b>0</b><br>0<br>9<br>5<br>0  | 0<br>8<br>5<br>8   | 11<br>11  
   | 9<br>(10  | <b>14</b><br>6  
  | <b>14</b><br><b>6</b>  
  | Wate<br>With  | r ner  
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  | l/m2<br>plant  |   |  |  |  |  
   |                    | (min<br>0)))<br>8<br>2<br>8   | Ave   | m          |
| 2<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none   | 0<br>0<br>9<br>5<br>0<br>9<br>0   | 0<br>8<br>5<br>8<br>0  | 0<br>11<br>7<br>11  
   | 9<br>10<br>10   | 14<br>14<br>14  
  | 14<br>14<br>14   
  | Wate<br>With  | r ner  
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  | l/m2<br>plant  |   |  |  |  |  
   |                    | (min<br>0)))<br>8<br>2<br>8<br>0  | Ave   |            |
| 2<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct   | 0<br>0<br>0<br>0<br>0   | 0<br>8<br>5<br>8<br>0<br>0   | 0<br>11<br>7<br>11<br>0<br>15   
   | 9<br>10<br><b>10</b>  | 14<br>14<br>14<br>0   
  | <b>14</b><br>14<br>0   
  | Wate<br>With<br>Max<br>16<br>21   | r ner<br>out co  
   | eds (<br>poling<br>17<br>17<br>0<br>27  
  | I/m2<br>plant  |   |  |  |  |  
   |                    | (min<br>(0))<br>8<br>2<br>8<br>0<br>11  | Ave   |            |
| 2<br>vol/h<br>4<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect   | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0  | 0<br>8<br>5<br>8<br>0<br>1,1<br>0  | <b>11</b><br><b>7</b><br><b>11</b><br><b>7</b><br><b>11</b><br><b>10</b><br><b>15</b><br><b>12</b>  
   | 9<br>10<br>0<br>10<br>13<br>10  | 14<br>14<br>14<br>0<br>19<br>13   
  | 14)<br>14<br>14<br>0)<br>19<br>12  
  | wate<br>With<br>16<br>21<br>14  | r ner<br>out co  
   | eds (<br>poling<br>17<br>17<br>0<br>27<br>16  
  | I/m2<br>plant<br>C<br>25<br>14   |   |  |  |  |  
   |                    | min<br>8<br>2<br>8<br>0<br>11<br>*7   | Ave   |            |
| 2<br>vol/h<br>4<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect  | 3<br><b>0</b><br><b>0</b><br><b>0</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>   | 0<br>8<br>8<br>5<br>8<br>8<br>0<br>1,1<br>8<br>7<br>1,1  | <b>0</b><br>11<br><b>7</b><br>11<br><b>0</b><br>15<br>12<br><b>1</b> 2  
   | 9<br>10<br><b>0</b><br>10<br>13<br>10<br>50<br>10<br>50<br>50<br>10<br>5145   | 14<br>14<br>0<br>19<br>13<br>20*  
  | <b>14</b><br><b>6</b><br>14<br><b>0</b><br>19<br>12<br>188   
  | wate<br>With<br>16<br>16<br>14<br>24  | r ner<br>out co<br>190<br>190<br>121<br>22   
   | eds (<br>poling<br>17.<br>17.<br>0<br>27<br>16.<br>29   
  | I/m2<br>plant  | 28<br>31  |  | 31<br>33   | 8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8  |  
   |                    | (min<br>8<br>2<br>8<br>0<br>11<br>7<br>11   | Ave   |            |
| 2<br>vol/h<br>4<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none  | \$<br><b>0</b><br><b>0</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>  | ■ 0  | 0<br>11<br>11<br>11<br>12<br>12<br>12<br>16<br>10   
   | 9<br>10<br>0<br>10<br>13<br>10<br>14<br>14<br>0   | 14<br>14<br>14<br>19<br>13<br>20×<br>0  
  | 14<br>14<br>0<br>19<br>19<br>12<br>18<br>18  
  | wate<br>With<br>16<br>16<br>14<br>24  | r ner<br>out
co<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter<br>inter   | eds (<br>poling<br>17<br>17<br>0<br>27<br>16<br>29   
   | I/m2<br>plant<br>5<br>5<br>14<br>25<br>14<br>27<br>27<br>0   | 28<br>31  |  | 33<br>33   | 8 4<br>8 4<br>8 30<br>8 30<br>8 32<br>8 4<br>8 4<br>8 4<br>8 4<br>8 4<br>8 4<br>8 4<br>8 4<br>8 4<br>8 4   |   
  |                    | (min<br>2<br>8<br>0<br>1,1<br>7<br>1,1<br>0   | Ave   |            |
| 2<br>vol/h<br>4<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>indirect<br>direct+indirect<br>direct+indirect<br>none<br>direct   | 3<br><b>0</b><br><b>0</b><br><b>0</b><br><b>1</b> ,1<br><b>8</b><br><b>8</b><br><b>1</b> ,1<br><b>0</b><br><b>1</b> ,3<br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>  | 0<br>0<br>1,1<br>1,1<br>0<br>1,1<br>0<br>1,3<br>0  | 0<br>11<br>11<br>11<br>11<br>12<br>15<br>12<br>16<br>16<br>18<br>18   
   | 9<br><b>35%</b><br>10<br><b>30%</b><br>10<br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b><br><b>10%</b> | 14<br>6<br>14<br>0<br>19<br>13<br>20<br>22<br>22  
  | 14<br>14<br>0<br>19<br>12<br>18<br>18<br>0<br>12<br>18<br>18   
  | wate<br>With<br>16<br>16<br>21<br>14<br>24<br>24  | r ner<br>out co<br>19<br>19<br>12<br>22  
   | eds (<br>poling<br>17.<br>17.<br>27<br>16.<br>29<br>0.<br>33  
  | I/m2<br>plant<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5   | 28%<br>31   |  | 31<br>33<br>40   | 200<br>30%<br>32%<br>38  |  
   |                    | min<br>8<br>2<br>8<br>0<br>11<br>7<br>11<br>0<br>13   | Ave   |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct  | 3<br>3<br>3<br>3<br>9<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3  | 0<br>0<br>11<br>0<br>11<br>0<br>13<br>0<br>0<br>13<br>0<br>0<br>13<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0  | 11<br>7<br>11<br>12<br>15<br>12<br>16<br>18<br>18<br>18   
   | 9<br><b>5</b><br>10<br><b>0</b><br>10<br><b>1</b><br><b>1</b><br><b>0</b><br><b>1</b><br><b>1</b><br><b>0</b><br><b>1</b><br><b>1</b><br><b>0</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>   | 14<br>14<br>0<br>19<br>13<br>20<br>22<br>16<br>16   
  | 14<br><b>0</b><br>14<br><b>0</b><br>19<br>12<br>18<br><b>0</b><br><b>2</b><br>12<br>14<br><b>0</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>   
  | wate<br>With<br>16<br>16<br>14<br>21<br>14<br>24<br>26<br>21  | r ner<br>out co<br>19<br>19<br>12<br>22<br>24<br>18  
   | eds (<br>poling<br>17.<br>17.<br>27<br>16.<br>29<br>0.<br>33<br>23  
  | I/m2<br>plant<br>25<br>14<br>27<br>0<br>30°<br>19  | 28<br>31<br>37<br>24  |  | 31<br>33<br>40<br>25   | 2000<br>8000<br>830%<br>830%<br>832%<br>838<br>838<br>823%   |  
   |                    | (min<br>80<br>2<br>8<br>0<br>11<br>7<br>11<br>0<br>13<br>8<br>9<br>13   | Ave   |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct  | 3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3<br>3  | 0<br>8<br>8<br>5<br>8<br>0<br>1,1<br>7<br>1,1<br>0<br>1,1<br>0<br>1,1<br>0<br>1,3<br>1,3<br>1,3<br>1,3<br>1,3<br>1,3<br>1,3<br>1,3   | 11<br>11<br>7<br>11<br>10<br>15<br>12<br>16<br>16<br>16<br>16<br>18<br>16<br>16<br>18<br>16<br>16<br>19<br>10   
   | 9<br><b>5</b><br>10<br><b>6</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>   | 14<br>14<br>0<br>19<br>13<br>20<br>0<br>22<br>16<br>22<br>22<br>16<br>22<br>22<br>16<br>22<br>22<br>16<br>22<br>22<br>16<br>22<br>22<br>22<br>22<br>22<br>22<br>22<br>22<br>22<br>2   
  | 14<br>14<br>14<br>19<br>12<br>18<br>21<br>14<br>21<br>14<br>21<br>14<br>21<br>14   
  | wate<br>With<br>16<br>16<br>14<br>21<br>14<br>24<br>26<br>21<br>26<br>21<br>26<br>21<br>28  | r ner<br>out co<br>19%<br>19%<br>12%<br>22<br>24<br>24<br>24   
   | eds (<br>poling<br>17.<br>17.<br>27.<br>16.<br>29.<br>33.<br>23.<br>35.   
  | I/m2<br>plant<br>25<br>14<br>27<br>0<br>30<br>19<br>32   | 28<br>31<br>37<br>24  | 29%<br>33%   | 31<br>33<br>40<br>25<br>43   | 800<br>30<br>32<br>38<br>23<br>40  | 2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>200  
   |                    | min<br>80<br>2<br>8<br>0<br>11<br>0<br>13<br>9<br>12  | Ave   |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>none<br>direct<br>indirect<br>direct<br>indirect<br>direct<br>indirect<br>direct<br>direct   |   | 888<br>5<br>888<br>0<br>1.1.1<br>78<br>8.1.1<br>0<br>8.1.3<br>8.12<br>8<br>0<br>0  | 11<br>11<br>7<br>11<br>0<br>15<br>12<br>16<br>16<br>18<br>16<br>18<br>16<br>19<br>0   
   | 9<br>10<br>08<br>138<br>10<br>138<br>10<br>138<br>168<br>13<br>178<br>10<br>13<br>178<br>10<br>13<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10   | 14<br>6<br>14<br>0<br>19<br>13<br>20<br>0<br>22<br>16<br>22<br>16<br>22<br>0<br>0   
  | 14<br>14<br>19<br>19<br>12<br>18<br>0<br>21<br>14<br>21<br>0<br>0<br>24  
  | wate<br>With<br>16.<br>21<br>14.<br>24<br>26<br>21<br>26<br>21<br>28<br>20<br>20  | r ner<br>out co<br>19<br>19<br>12<br>22<br>24<br>24<br>18<br>26<br>27  
   | eds (<br>poling<br>*17.<br>*17.<br>*16.<br>29<br>*0.<br>*33<br>*35<br>*0.<br>**********************************   
  | I/m2<br>plant<br>25<br>14<br>27<br>0<br>30<br>19<br>32   | 28<br>31<br>37<br>24<br>41  |  | 33<br>33<br>40<br>25<br>43<br>00   | 38<br>38<br>323<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38  |
<b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1000</b><br><b>1</b> |                    | min<br>8<br>2<br>8<br>0<br>11<br>7<br>11<br>0<br>13<br>9<br>12<br>0   | Ave<br>   |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect   | x<br>x<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y   | 8<br>8<br>5<br>8<br>8<br>0<br>11<br>7<br>11<br>0<br>13<br>9<br>12<br>0<br>14<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10   | 11<br>11<br>11<br>11<br>12<br>15<br>12<br>16<br>16<br>18<br>18<br>16<br>19<br>19<br>20  
   | 9<br><b>5</b><br>10<br><b>5</b><br>10<br><b>5</b><br>13<br>10<br><b>5</b><br>14<br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>   | 14<br>6<br>14<br>0<br>13<br>20<br>0<br>22<br>16<br>22<br>16<br>22<br>16<br>22<br>18   
  | 14<br>14<br>14<br>19<br>19<br>12<br>18<br>18<br>21<br>14<br>21<br>14<br>21<br>8<br>21<br>8<br>24<br>8<br>24  
  | wate<br>With<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%   | r ne<br>out
co<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>intervention<br>interv   | eds (<br>poling<br>*17*<br>*17*<br>27<br>*16*<br>29<br>*0*<br>*33<br>23<br>*35*<br>*0**<br>*37*   
  | I/m2<br>plant<br>25<br>14<br>27<br>0<br>30 <sup>2</sup><br>19<br>32<br>0<br>0<br>30 <sup>2</sup><br>19<br>32<br>0<br>0<br>30 <sup>2</sup><br>24  | 28<br>28<br>31<br>37<br>24<br>41<br>41<br>44<br>44<br>34  | 29%<br>33%<br>38%<br>38%   | ×31×<br>×31×<br>×31×<br>×31×<br>×31×<br>×31×<br>×31×<br>×31×                     | 38<br>38<br>23<br>38<br>23<br>40<br>38<br>23<br>40<br>38   | x41<br>x45<br>50<br>24   
   |                    | min<br>8<br>2<br>8<br>0<br>11<br>7<br>11<br>0<br>13<br>9<br>12<br>0<br>14<br>8<br>12<br>0<br>14<br>14<br>14<br>14<br>14<br>14<br>14<br>14<br>14<br>14   | Ave<br>22<br>122<br>122<br>24<br>24<br>28<br>18<br>30<br>032<br>232   |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct<br>indirect<br>direct<br>indirect<br>direct  | x<br>x<br>y<br>y<br>y<br>y<br>x<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y  | 8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>11<br>11<br>11<br>11   | 11<br>11<br>11<br>12<br>15<br>12<br>16<br>16<br>18<br>16<br>18<br>18<br>16<br>19<br>19<br>19<br>19<br>20  
   | 9<br><b>5</b><br>10<br><b>6</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>   | 14<br>14<br>0<br>19<br>13<br>20<br>0<br>22<br>16<br>22<br>16<br>22<br>16<br>22<br>18<br>25<br>25<br>18  
  | x14<br>x6<br>x19<br>x19<br>x19<br>x18<br>x21<br>x21<br>x21<br>x21<br>x21<br>x21<br>x21<br>x21<br>x21<br>x21  
  | wate<br>With<br>%16%<br>21<br>%14%<br>24<br>%26<br>21<br>%29%<br>%0%<br>%30%<br>233%  | <b>r</b> ne cout co<br>out co<br><b>r</b> 19<br><b>19</b><br><b>19</b><br><b>19</b><br><b>19</b><br><b>19</b><br><b>19</b><br><b>19</b><br><b>1</b>  
   | eds (<br>poling<br>*17*<br>*17*<br>27<br>*16*<br>29<br>*0*<br>*33<br>23<br>*35<br>*35<br>*35<br>*37*<br>*39   
  | I/m2<br>plant<br>25<br>14<br>27<br>30<br>19<br>30<br>19<br>832<br>834<br>24<br>36  | 28<br>28<br>31<br>37<br>37<br>24<br>41<br>44<br>44<br>34<br>48  |  | 33<br>33<br>40<br>25<br>43<br>33<br>40<br>25<br>43<br>43<br>40<br>43<br>43<br>49 | 230<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38  | ×33×<br>×33×<br>×41×<br>45<br>50<br>×31×<br>54   
   |                    | min<br>8<br>2<br>8<br>0<br>11<br>7<br>11<br>0<br>13<br>9<br>12<br>0<br>14<br>10<br>14   | Ave<br>*15:<br>22<br>*12:<br>24<br>*0<br>28<br>18<br>30<br>*0<br>*0<br>*2<br>34   |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>indirect<br>mine<br>direct<br>indirect  | x<br>x<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y   | Image: Constraint of the second sec  | × 0     × 0     × 1     × 0     × 1     × 0     × 1     × 0     × 1     × 0     × 1     × 0   | 9<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>55%<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10  
   | 14<br>14<br>14<br>19<br>13<br>20<br>22<br>16<br>22<br>16<br>22<br>16<br>22<br>16<br>22<br>16<br>22<br>16<br>22<br>16<br>22<br>16<br>22<br>16<br>22<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20  
  | x14x<br>x6<br>14<br>x0<br>x19x<br>12<br>x19x<br>12<br>x19x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x<br>x21x   
  | wate<br>With<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%   | r ne.<br>out cc<br>www.<br>www.<br>www.<br>www.<br>www.<br>www.<br>www.<br>w   
   | eds (<br>poling<br>%%%<br>%%%<br>%%%<br>%%%<br>%%%<br>%%%<br>%%%<br>%%%<br>%%%<br>%  | I/m2<br>plant<br>plant<br>2<br>2<br>3<br>0<br>3<br>0<br>3<br>0<br>3<br>0<br>3<br>0<br>3<br>0<br>3<br>2<br>4<br>3<br>6<br>3<br>6<br>0   
   | 228<br>28<br>28<br>31<br>37<br>37<br>24<br>31<br>41<br>44<br>44<br>34<br>44<br>34<br>48<br>30   | 29%<br>29%<br>29%<br>33%<br>33%<br>38%<br>38%<br>38%<br>38%<br>38%<br>38%<br>38%<br>38       | ×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×               | 8  | ×33×<br>×33×<br>×41×<br>50<br>×31×<br>54<br>0  |                    | min<br>0<br>2<br>8<br>0<br>11<br>7<br>11<br>0<br>13<br>9<br>12<br>0<br>14<br>10<br>10<br>10<br>0   
  | Ave<br>************************************   |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>indirect<br>indirect<br>Mine<br>direct<br>Mine<br>direct<br>Ave<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Market<br>Marke   | x<br>x<br>y<br>y<br>x<br>y<br>y<br>x<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y   | Image: Constraint of the second sec  | x 0 x 1<br>11<br>x 7 x 1<br>x 1 2<br>x 1 5 x 1<br>x 1 5 x 1<br>x 1 5 x 1<br>x 1 6 x 1<br>x 1 7 x 1<br>x 1 | 9<br>35<br>10<br>35<br>10<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35   
   | x14x<br>x6<br>x14<br>x0<br>x19x<br>13<br>x20x<br>x16x<br>x22x<br>x16x<br>x22x<br>0<br>x22x<br>x16x<br>x22x<br>x16x<br>x22x<br>x16x<br>x22x<br>x16x<br>x22x<br>x16x<br>x22x<br>x18x<br>x25x<br>x18x<br>x25<br>x18x<br>x25<br>x18x<br>x25<br>x13x<br>x14x<br>x14x<br>x14x<br>x14x<br>x14x<br>x14x<br>x14x   
  | 14<br>14<br>14<br>19<br>12<br>18<br>12<br>18<br>12<br>14<br>21<br>14<br>21<br>14<br>21<br>14<br>21<br>14<br>21<br>14<br>21<br>14<br>21<br>14<br>21<br>14<br>12<br>14<br>21<br>14<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12   
  | wate<br>With<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%   | r ne.<br>out cc<br>www.<br>www.<br>www.<br>www.<br>www.<br>www.<br>www.<br>w   | eds (<br>poling<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%  
  | I/m22<br>plant   | 224<br>31<br>37<br>24<br>41<br>44<br>34<br>44<br>34<br>44<br>34<br>34<br>34<br>34<br>34<br>34<br>34<br>34   | 29%<br>29%<br>29%<br>33%<br>38%<br>38%<br>38%<br>38%<br>38%<br>38%<br>38%<br>38%<br>38       | **************************************                             
             | 234<br>38<br>38<br>38<br>40<br>40<br>43<br>29<br>45<br>0<br>21   | ×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×<br>×   |                    | min<br>0<br>2<br>8<br>0<br>11<br>7<br>11<br>0<br>13<br>9<br>14<br>10<br>14<br>0<br>14<br>10<br>14<br>0<br>14<br>10<br>14<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10  | Ave<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4   
  |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>indirect<br>indirect<br>mone<br>direct<br>max   | xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx  | 2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>200<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2 | x 0<br>11<br>7<br>12<br>15<br>12<br>15<br>12<br>15<br>12<br>15<br>12<br>15<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12  
   | 9<br>% 5%<br>10<br>% 0%<br>% 13%<br>10<br>% 14%<br>% 0%<br>% 16%<br>% 17%<br>% 0%<br>% 18%<br>16<br>% 20%<br>% 0%<br>10<br>% 0%<br>% 10<br>% 0%<br>% 10<br>% 0%<br>% 10<br>% 10   | 14<br>14<br>0<br>14<br>0<br>19<br>13<br>22<br>16<br>22<br>16<br>22<br>18<br>22<br>18<br>25<br>13<br>25<br>13<br>25<br>25<br>13<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25  
  | x14<br>x6<br>x6<br>x19<br>x19<br>x19<br>x12<br>x18<br>xx0<br>x21<br>x14<br>x21<br>x14<br>x21<br>x14<br>x21<br>x14<br>x21<br>x14<br>x21<br>x14<br>x21<br>x14<br>x21<br>x14<br>x21<br>x14<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19  
  | wate           With           With           Res           Res  <                               | r ne<br>out cc<br>www.<br>www.<br>www.<br>www.<br>www.<br>www.<br>www.<br>w  | eds<br>ooling<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%  
  | I/m22<br>plant   
   | 224%<br>31<br>37<br>24%<br>41<br>44<br>34<br>44<br>34<br>44<br>34   | 2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>200                                  | **************************************   | 223<br>38<br>323<br>40<br>38<br>40<br>40<br>43<br>29<br>45<br>0<br>211<br>211  | 2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>200  |                    | Imin           8           2           8           0           114           7           11           0           33           9.4.12           0           114.2           114.2           114.2           114.2           114.2           114.2           114.2           114.2           114.2           114.2           114.2           114.2           114.2           114.2           114.2           114.2   | Ave<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4   
  |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>indirect<br>indirect<br>mine<br>direct<br>indirect<br>Mine<br>direct<br>indirect<br>Mine<br>direct<br>indirect<br>Mine<br>direct<br>indirect<br>Mine<br>direct<br>indirect<br>Mine<br>direct<br>indirect<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct<br>Mine<br>direct   | Image: Second  | Image: Constraint of the second sec  | x 0<br>11<br>7<br>12<br>15<br>12<br>16<br>0<br>18<br>18<br>19<br>20<br>19<br>222<br>20<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>12<br>15<br>15<br>15<br>12<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15  | 9<br>9<br>5<br>10<br>10<br>13<br>148<br>13<br>148<br>13<br>17<br>13<br>17<br>13<br>17<br>18<br>18<br>13<br>17<br>18<br>10<br>12<br>14<br>10<br>14<br>10<br>14<br>10<br>14<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10  
  | 14<br>14<br>0<br>14<br>0<br>19<br>13<br>120<br>13<br>120<br>0<br>13<br>225<br>16<br>25<br>18<br>0<br>25<br>13<br>13<br>13<br>13<br>13<br>13<br>13<br>13<br>13<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15  
   | x14<br>x6<br>x14<br>x6<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19<br>x19  
   | wate<br>With<br>%44<br>%16%<br>%16%<br>%16%<br>%14<br>%24<br>%14<br>%26<br>21<br>%29%<br>%30%<br>27<br>33%<br>%30%<br>%16%<br>%16%<br>%16%<br>%16%<br>%16%<br>%16%<br>%16%<br>%1  | r ne:<br>out cco   | eds (<br>ooling<br>000<br>17<br>16<br>16<br>27<br>16<br>27<br>16<br>27<br>16<br>28<br>33<br>23<br>33<br>35<br>35<br>30<br>35<br>30<br>37<br>28<br>337<br>28<br>337<br>19<br>28<br>39<br>19   
   | I/m22<br>plant<br>225<br>144<br>27<br>30<br>19<br>322<br>30<br>30<br>19<br>322<br>30<br>34<br>24<br>36<br>34<br>34<br>34<br>34<br>34<br>34<br>34<br>34<br>34<br>34<br>34<br>34<br>34   | 224<br>31<br>37<br>224<br>41<br>44<br>34<br>48<br>80<br>80   
  | 2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>200                                  | **************************************   | 8  | 2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>200  |                    | min<br>0<br>11<br>11<br>11<br>11<br>11<br>11<br>11<br>11<br>11  | Ave<br>400<br>400<br>400<br>400<br>400<br>400<br>400<br>40  
   |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h<br>Åir flow<br>2  | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>maxi<br>Evap.system<br>ind.+Cool. plant   | x<br>x<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y<br>y   | Image: Constraint of the second sec  | 0           11           7           11           7           11           0           15           12           16           18           19           220           194           220           193           220           12           22           12           22           12           22           12           22           12           22           12           22           12           22           12           22           12           22           22           22           22           22           22           22           22           22           22           22           22           22           22           23           24           25   | 9<br>9<br>5<br>10<br>8<br>13<br>10<br>8<br>13<br>10<br>8<br>14<br>8<br>10<br>8<br>14<br>8<br>10<br>8<br>14<br>8<br>8<br>10<br>8<br>17<br>8<br>8<br>10<br>8<br>17<br>8<br>8<br>10<br>8<br>17<br>8<br>8<br>10<br>8<br>10  
   | 14:3           14           14           14           14           14           14           14           14           14           14           14           14           14           14           13           20*           13           22*           0           22*           0           22*           0           22*           0           22*           0           22*           0           22*           0           22*           0           22*           0           22*           0           22*           0           25           0.0%           13           3           3           4           0.0%           13           14           15           16           17   
  | 14<br>14<br>14<br>14<br>14<br>12<br>18<br>12<br>12<br>18<br>22<br>21<br>21<br>21<br>21<br>21<br>21<br>21<br>21<br>21   
  | wate           With   | r ne.<br>out cccourse<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sectors<br>sec  
   | eds (<br>ooling<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%<br>%   | I/m2/<br>plant<br>25<br>14/<br>27<br>27<br>19<br>32<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>19<br>32<br>30<br>30<br>19<br>19<br>32<br>30<br>30<br>19<br>19<br>32<br>30<br>30<br>19<br>19<br>19<br>19<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10  
   | 24%<br>31<br>37<br>24%<br>41<br>44<br>34<br>88%<br>21%  |  | **************************************   | **************************************   | 1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>100<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1000<br>1   |                    | min<br>8<br>8<br>2<br>8<br>0<br>11<br>7<br>11<br>7<br>11<br>0<br>13<br>3<br>9<br>14<br>10<br>14<br>10<br>14<br>14<br>14<br>14<br>14<br>14<br>14<br>14<br>14<br>14   | Ave<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4<br>4   
  |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h   | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>wine<br>direct<br>indirect<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect  | Image: Second  | Image: Constraint of the second sec  |   | 9<br>9<br>10<br>%13%<br>10<br>%13%<br>10<br>%13%<br>%13%<br>%13%<br>%13%   
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Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br><b>direct</b><br>indirect<br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>direct</b><br><b>d</b> | Image: Constraint of the second sec | 880<br>885<br>5<br>888<br>5<br>888<br>0<br>0<br>111<br>877<br>877<br>877<br>877<br>877<br>877<br>877   | 0           11           7           11           0           15           12           16           18           19           22:           0           12           16           17           18           19           22:           0           12           20           11           10           22:           02:           20:           12:           22:           02:           20:           12:           22:           03:           12:           20:   | 9<br>9<br>5<br>10<br>%<br>0<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>14<br>%<br>%<br>0<br>%<br>%<br>16<br>%<br>17<br>%<br>%<br>16<br>%<br>17<br>%<br>%<br>16<br>%<br>17<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>10<br>%<br>%<br>%<br>% 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  | x14x<br>x14x<br>x14<br>x14<br>x14<br>x14<br>x14<br>x14<br>x12<br>x12<br>x12<br>x12<br>x21x<br>x12<br>x21x<br>x12<br>x21x<br>x12<br>x21x<br>x12<br>x21x<br>x12<br>x21x<br>x12<br>x12  
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   | I/m2           plant           25           814//           25           814//           27           80//           30/           19           32//           80//           814//           88//           80//   | 28%<br>31<br>37<br>24%<br>41<br>44<br>34<br>48%<br>00%<br>21%<br>50%<br>50%<br>50%<br>50%<br>50%<br>50%<br>50%<br>50%<br>50%<br>50   
  |  | **************************************   | 29<br>45<br>0<br>21<br>29<br>45<br>0<br>29<br>45<br>0<br>29<br>45<br>0<br>29<br>45<br>0<br>29<br>45<br>0<br>29<br>45<br>0<br>29<br>17  | 2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>200  |                    | min<br>80<br>2<br>8<br>0<br>11<br>11<br>0<br>13<br>9<br>12<br>0<br>14<br>14<br>14<br>14<br>14<br>14<br>14<br>14<br>14<br>14   |
Ave<br>*15:<br>*12:<br>22:<br>*12:<br>24:<br>*0:<br>28:<br>18:<br>30:<br>*0:<br>*32:<br>23:<br>34:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:<br>*16:    |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h<br>Air flow<br>2<br>vol/h<br>4<br>vol/h                               | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>Maxe<br>Evap.system<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant   | Image: Constraint of the second sec | 880<br>888<br>5<br>1887<br>0<br>111<br>111<br>111<br>111<br>111<br>111<br>111  | Image: Constraint of the second sec   | 9<br>%<br>5<br>10<br>%<br>10<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>10<br>%<br>13<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%<br>10<br>%   
   | 14.3           14           14           14           14           13           20.4           13           220.4           13           220.4           13           220.4           13           220.4           14           220.4           120.4           13           225.4           0           225.4           0.0           12.4           20.4  
  | x14x<br>x14x<br>x14<br>x14<br>x14<br>x19x<br>x19x<br>x19x<br>x19   
  | wate<br>With<br>16<br>16<br>16<br>21<br>21<br>24<br>26<br>21<br>24<br>28<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8   | r ne:<br>out cccould could   | eds         ()  
   | I/m22<br>plant<br>plant<br>25<br>14<br>25<br>14<br>27<br>30<br>19<br>32<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>19<br>32<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30  | 224<br>31<br>37<br>224<br>31<br>37<br>224<br>31<br>37<br>224<br>31<br>37<br>224<br>31<br>37<br>224<br>31<br>37<br>224<br>31<br>37<br>224<br>31<br>37<br>224<br>31<br>37<br>224<br>31<br>37<br>224<br>31<br>31<br>37<br>224<br>31<br>31<br>32<br>24<br>31<br>31<br>32<br>31<br>32<br>31<br>32<br>31<br>32<br>31<br>32<br>31<br>32<br>32<br>31<br>32<br>32<br>31<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32  |  | **************************************   |
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| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>6<br>vol/h<br>8<br>vol/h<br>8<br>vol/h | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>indirect<br>direct+indirect<br>direct+indirect<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>www.Ave<br>www.Ave<br>www.<br>Evap.system<br>ind.+Cool.plant<br>cool.plant only<br>ind.+Cool.plant<br>cool.plant only<br>ind.+Cool.plant<br>cool.plant only<br>ind.+Cool.plant<br>cool.plant only<br>ind.+Cool.plant<br>cool.plant only<br>ind.+Cool.plant<br>cool.plant only<br>ind.+Cool.plant<br>cool.plant only<br>ind.+Cool.plant   | Image: Constraint of the second sec | (0)     (  |   | 9<br>5<br>10<br>5<br>10<br>5<br>10<br>5<br>5<br>10<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5<br>5   
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   |            |
| 2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>6<br>vol/h<br>8<br>vol/h<br>8<br>vol/h | Evap.system<br>none<br>direct<br>indirect<br>direct+indirect<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>wind:rect<br>direct+indirect<br>direct+indirect<br>Mine<br>Max<br>Evap.system<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant   |   | \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$   |   
   | 9<br>5<br>10<br>5<br>10<br>5<br>10<br>10<br>13<br>13<br>14<br>13<br>17<br>13<br>16<br>13<br>17<br>13<br>17<br>10<br>13<br>17<br>10<br>13<br>17<br>10<br>13<br>17<br>10<br>13<br>10<br>10<br>14<br>18<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10  | x14:<br>x6<br>14<br>x0<br>x19<br>13<br>x20<br>x0<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x22<br>x18<br>x18<br>x22<br>x18<br>x22<br>x18<br>x18<br>x22<br>x18<br>x18<br>x22<br>x18<br>x18<br>x18<br>x18<br>x18<br>x18<br>x18<br>x18  
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Solar gains S*Agla2/Noom         0.05         0.15           Int.gain w/m* (Bh to 18h)         10         30         10         30           Intrata         High         Low         High         Low         High         Low           Air flow         Evep.system         Without cooling plant         min         F         Without cooling plant         min         F           Air flow         Evep.system         Without cooling plant         min         F         Without cooling plant         min         F           4         none         19 (20 (20 (55) (24))         10 (20 (15) (24))         10 (20 (15) (24))         10 (20 (15) (24))         10 (20 (26) (26) (26) (26) (26) (26) (26) (26)										3	/m2	kWh	ds (	nee	ina	leat	ł				5	e year : Carpentra	Referenc
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   | 47<br>\$52<br>46<br>59<br>60<br>46<br>49<br>8  | 36<br><b>39</b><br>45<br><b>4</b> 2<br>50<br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b>  | 55<br><b>\$52</b><br>64<br><b>\$62</b><br><b>\$62</b><br><b>\$65</b><br><b>\$73</b><br><b>\$66</b><br><b>\$66</b>  
   | 53<br><b>49</b><br>61<br><b>60</b><br>62<br>70<br>62<br><b>60</b><br><b>62</b><br><b>60</b><br><b>62</b><br><b>64</b>  | *59)<br>76<br>69<br>*81<br>*89<br>75   
  | 52<br>66<br>60<br>71<br>79<br>66  | *74¥<br>91<br>88<br>\$88<br>\$7%<br>\$106<br>\$97%   | 68<br>82<br>81<br>77<br>97<br>90   | <b>103</b><br><b>103</b><br>97<br><b>108</b><br>126<br>■<br>109  
   | 108<br>95   | 106<br>130<br>120   | 112   
  | 1145<br>1127   |  | 31<br>34<br>34<br>39<br>39<br>38<br>38<br>38<br>43<br>45<br>50<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10   | 1611<br>76<br>74<br>74<br>74<br>92<br>82  
   |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect   | 36<br>«40»<br>»39»<br>«45»<br>«46»<br>«46»<br>«42»<br>«53»   | 34<br>\$39<br><b>0</b><br><b>0</b><br><b>0</b><br><b>0</b><br><b>0</b><br><b>0</b><br><b>0</b><br><b>0</b>  
   | 47<br>\$52<br>\$46<br>\$46<br>\$60<br>\$49<br>\$68   | 36<br><b>39</b><br>45<br><b>42</b><br>50<br><b>50</b><br><b>53</b><br><b>45</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b>   | 55<br><b>\$52</b><br>64<br><b>\$62</b><br><b>\$62</b><br><b>\$73</b><br><b>\$66</b><br><b>\$76</b>   
   | 53<br><b>49</b><br>61<br><b>6</b><br>62<br>70<br>62<br>70<br>64<br>73  | *59)<br>76<br>69<br>*81<br>89<br>75<br>*95*  
  | 52<br>66<br>71<br>79<br>66<br>82  | 91<br>91<br>88<br>88<br>87<br>106<br>897<br>104  | <b>68</b><br>82<br>81<br>77<br>97<br>90<br>90  | 277<br>103<br>97<br>108<br>126<br>109<br>131   
   | 108<br>95   | 106<br>130<br>120<br>120  | 120<br>112<br>112   
  | 109<br>1145<br>127   |  | 31<br>34<br>34<br>39<br>39<br>38<br>38<br>43<br>45<br>51<br>51   | ■ 100 million (100 million)       1     1       76     76       776     92       92     82       82     82  
   |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect  | 36<br>×40×<br>×39×<br>×45×<br>×46×<br>×46×<br>×46×<br>×46×<br>×46×<br>×42×<br>×53×<br>×51×   | 34<br>\$39<br><b>\$39</b><br><b>\$38</b><br><b>\$43</b><br><b>\$45</b><br><b>\$0</b><br><b>\$428</b><br><b>\$428</b><br><b>\$428</b><br><b>\$50</b>   
   | 47<br>\$52<br>47<br>\$52<br>\$46<br>\$<br>59<br>\$60<br>\$<br>49<br>\$<br>68<br>\$<br>68<br>\$<br>66<br>\$   | 36<br><b>39</b><br>45<br><b>42</b><br>50<br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b>   |
55<br><b>\$52</b><br><b>64</b><br><b>\$62</b><br><b>\$65</b><br><b>\$73</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b>   | 53<br><b>49</b><br>61<br><b>60</b><br>62<br>70<br><b>62</b><br>70<br><b>64</b><br>73<br>77   | *59<br>76<br>69<br>*81<br>89<br>75<br>*95<br>*97*  
  | <b>52</b><br><b>66</b><br><b>71</b><br><b>79</b><br><b>66</b><br><b>82</b><br>86  | *74¥<br>91<br>88<br>*106<br>*106<br>*97*<br>104  | 82<br>82<br>81<br>77<br>97<br>90<br>90<br>90<br>90<br>90   | 97<br>103<br>97<br>126<br>109<br>109<br>140  
   | 108<br>95<br>125  | 106<br>106<br>106<br>100<br>130<br>120<br>120<br>120  | 120<br>134  
  | 109<br>145<br>127  |  | 31<br>34<br>34<br>39<br>39<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38   | 1615           76           77          
77           77           77           92           82           82           103  |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect  | 36<br>«40»<br>»39»<br>«45»<br>«45»<br>«45»<br>«42»<br>«53»<br>«51»<br>«0»  | 34<br>39»<br>39»<br>38»<br>43»<br>43»<br>45»<br>842»<br>51%<br>250%<br>20%  
   | 47<br>\$52<br>47<br>\$52<br>46<br>59<br>\$60<br>\$60<br>\$60<br>\$60<br>\$66<br>\$66<br>\$66<br>\$66   | 36<br><b>39</b><br>45<br><b>42</b><br>50<br><b>53</b><br><b>45</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b>   | 55<br><b>52</b><br>64<br><b>62</b><br><b>62</b><br><b>73</b><br><b>66</b><br><b>76</b><br><b>80</b>  
   | 53<br><b>49</b><br>61<br><b>60</b><br>62<br>70<br>64<br>73<br>77<br>0  | *59<br>76<br>69<br>*81<br>89<br>75<br>*95<br>*97<br>*95  
  | <b>52</b><br><b>66</b><br><b>71</b><br>60<br><b>71</b><br>66<br><b>82</b><br>86<br><b>6</b>   | 91<br>88<br>88<br>87<br>106<br>97<br>104<br>117<br>0   | 82<br>82<br>81<br>77.<br>97<br>90<br>90<br>90<br>90<br>90<br>82<br>80  | 97<br>103<br>97<br>108<br>126<br>109<br>109<br>131<br>140<br>0   
   | 108<br>95<br>125  | 106<br>106<br>106<br>100<br>130<br>120<br>120<br>120<br>144   | 120<br>1112<br>134<br>0   
  | 109<br>145<br>127<br>165   |  | 31<br>34<br>34<br>39<br>39<br>39<br>30<br>38<br>38<br>38<br>34<br>38<br>34<br>38<br>34<br>38<br>34<br>32<br>50<br>50<br>50<br>50   | <ul> <li>▲611</li> <li>76</li> <li>74</li> <li>₹76</li> <li>92</li> <li>82</li> <li>82</li> <li>83</li> <li>103</li> </ul>  
   |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect  | 36<br>40<br>39<br>45<br>46<br>0<br>45<br>53<br>51<br>0<br>29   | 34<br>39)<br>39)<br>38)<br>43)<br>43)<br>442)<br>42)<br>50)<br>50)<br>30)<br>29   
   | 47<br>\$52<br>47<br>\$52<br>46<br>59<br>\$60<br>\$46<br>\$60<br>\$60<br>\$60<br>\$60<br>\$60<br>\$60<br>\$60<br>\$6  | 30<br><b>39</b><br>45<br><b>42</b><br>50<br><b>53</b><br><b>45</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b>   |
55<br><b>\$52</b><br>64<br><b>\$62</b><br><b>\$62</b><br><b>\$62</b><br><b>\$65</b><br><b>\$73</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b>\$66</b><br><b></b>   | 53<br><b>49</b><br>61<br><b>60</b><br>62<br>70<br><b>64</b><br><b>73</b><br>77<br><b>0</b><br><b>43</b>  | *59<br>76<br>69<br>81<br>89<br>75<br>95<br>89<br>89<br>89<br>75<br>89<br>75<br>89<br>75  
  | <b>52</b><br><b>66</b><br><b>71</b><br>79<br><b>66</b><br><b>82</b><br>86<br><b>0</b>   | 91<br>88<br>88<br>87<br>106<br>97<br>104<br>117,<br>80   | 82<br>81<br>97<br>97<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90   | <b>103</b><br>97<br><b>108</b><br>126<br><b>109</b><br>131<br>140<br><b>0</b>  
   |   | 106<br>106<br>106<br>130<br>120<br>120<br>120<br>144  |
<b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>113</b><br><b>112</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>113</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>115</b><br><b>1</b> | 109<br>145<br>127<br>165<br>0  |  | 31<br>34<br>34<br>39<br>39<br>39<br>30<br>38<br>38<br>43<br>45<br>50<br>50<br>50  
  | K611     76     74     74     74     74     92     82     82     82     83     103     8  |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect   | 36<br>40<br>39<br>45<br>45<br>46<br>51<br>0<br>29  | 34<br>39×<br>38×<br>43×<br>43×<br>442×<br>51×<br>250×<br>30×<br>29  
   | 47<br>\$52<br>47<br>\$52<br>46<br>59<br>*60<br>*60<br>*60<br>*60<br>*60<br>*60<br>*60<br>*60   | 30<br><b>39</b><br>45<br><b>4</b> 2<br>50<br><b>53</b><br><b>4</b> 5<br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b> |
55<br><b>52</b><br>64<br><b>62</b><br><b>62</b><br><b>65</b><br><b>73</b><br><b>66</b><br><b>76</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b> | 53<br><b>49</b><br>61<br><b>60</b><br>62<br>70<br><b>64</b><br>73<br>77<br><b>0</b><br><b>43</b>   | *59<br>76<br>69<br>*81<br>89<br>75<br>*95<br>*97<br>*0<br>*  
  | 52<br>66<br>71<br>79<br>66<br>82<br>86<br>0   | 91<br>88<br>87<br>106<br>97<br>104<br>117,<br>80<br>80   | 82<br>81<br>97<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90   | <b>37.7</b><br><b>103</b><br><b>97</b><br><b>108</b><br><b>126</b><br><b>109</b><br><b>131</b><br><b>140</b><br><b>0</b>   
   | 831<br>831<br>108<br>95<br>125  | 106<br>106<br>106<br>130<br>120<br>120<br>120<br>144  |
<b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>112</b><br><b>1</b> | 109<br>145<br>127<br>165<br>0  |  | 31<br>34<br>34<br>39<br>39<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38  
  | €615           76           776           92           82           82           103           ※52 %  |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br><b>direct+indirect</b>   | 36<br>40<br>39<br>39<br>45<br>46<br>53<br>51<br>0<br>29  | 34<br>39%<br>38%<br>43%<br>43%<br>44%<br>44%<br>51%<br>250%<br>50%<br>29  
   | 47<br>\$52<br>47<br>\$52<br>46<br>59<br>60<br>46<br>68<br>68<br>68<br>68<br>68<br>68<br>37<br>37   | 36<br><b>39</b><br>45<br>50<br><b>53</b><br><b>45</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b>   |
55<br><b>\$52</b><br>64<br><b>\$62</b><br><b>\$65</b><br><b>\$73</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$0</b><br><b>\$\$0</b><br><b>\$\$0</b><br><b>\$\$0</b><br><b>\$\$0</b><br><b>\$\$0</b><br><b>\$\$0</b><br><b>\$\$0\$\$\$0\$\$0\$\$0\$\$0\$\$0\$\$0\$\$0\$\$0\$\$0\$\$0\$0</b> 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53<br><b>49</b><br>61<br><b>60</b><br>62<br>70<br>64<br>73<br>77<br><b>64</b><br><b>64</b><br><b>73</b><br><b>77</b><br><b>64</b><br><b>64</b><br><b>64</b><br><b>65</b><br><b>67</b><br><b>66</b><br><b>62</b><br><b>70</b><br><b>66</b><br><b>67</b><br><b>66</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>67</b><br><b>6</b> | *59<br>76<br>69<br>81<br>89<br>75<br>95<br>89<br>89<br>89<br>75<br>89<br>75<br>89<br>75<br>89<br>75<br>89<br>75  
  | 52<br>66<br>71<br>79<br>66<br>82<br>86<br>0   | *74×<br>91<br>88<br>*106<br>*106<br>*106<br>*106<br>*106<br>*106<br>*106<br>*106   | 82<br>81<br>877.<br>97<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90   | 277<br>103<br>97<br>108<br>126<br>109<br>131<br>140<br>0<br>0  
   | 108<br>125<br>0   | 106<br>106<br>106<br>102<br>130<br>120<br>120<br>123<br>144<br>10   | 120<br>112<br>112<br>134<br>0   
  | 109<br>145<br>127<br>165<br>0  |  | 31<br>34<br>34<br>39<br>39<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38<br>38   | 1615           76           776          
776           92           82           103           103           103   |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>ir flow   | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect  | 36<br>40<br>39<br>45<br>45<br>46<br>0<br>42<br>53<br>51<br>0<br>29<br>0<br>29  | 34<br>39%<br>38%<br>43%<br>43%<br>43%<br>43%<br>43%<br>43%<br>43%<br>25%<br>29  
   | 47<br>\$52<br>47<br>\$52<br>46<br>59<br>60<br>460<br>49<br>68<br>68<br>68<br>68<br>68<br>68<br>37<br>37<br>38<br>49<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>5   | 36<br><b>39</b><br>45<br>50<br><b>53</b><br><b>45</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>59</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b><br><b>50</b>   |
55<br><b>52</b><br>64<br><b>62</b><br><b>65</b><br><b>73</b><br><b>66</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b> | 53<br><b>49</b><br>61<br><b>60</b><br>62<br>70<br><b>62</b><br>70<br><b>64</b><br><b>73</b><br><b>77</b><br><b>64</b><br><b>43</b><br><b>43</b><br><b>43</b>   | *59<br>76<br>69<br>81<br>89<br>75<br>95<br>89<br>89<br>89<br>89<br>89<br>89<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80  
  | 52<br>66<br>60<br>71<br>66<br>82<br>86<br>0<br>82<br>86<br>0<br>0<br>1 coo  | *74<br>91<br>88<br>*106<br>*106<br>*97<br>104<br>*117<br>*0<br>*60<br>*60  | 82<br>81<br>877.∞<br>97<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90  | 277<br>103<br>97<br>108<br>126<br>109<br>131<br>140<br>0<br>131<br>140<br>0  
   |   | 106<br>106<br>106<br>102<br>130<br>120<br>120<br>123<br>144<br>10   | 120<br>112<br>112<br>134<br>0   
  | 109<br>145<br>127<br>165<br>0  |  | 31<br>34<br>34<br>34<br>39<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50   |
€11<br>76<br>74<br>₹76<br>92<br>82<br>82<br>893<br>103<br>852<br>852<br>8<br>4ve  |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>ir flow<br>2  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>Mirect<br>direct+indirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>Mirect<br>M  | 36<br>40<br>39<br>45<br>46<br>0<br>45<br>51<br>51<br>0<br>29<br>23<br>51<br>23<br>51<br>51<br>51<br>51<br>51<br>51<br>51<br>51<br>51<br>51   | 34<br>\$39<br>\$38<br>\$43<br>\$43<br>\$45<br>\$45<br>\$42<br>\$51<br>\$50<br>\$29<br>\$22<br>\$  
   | 47<br>52%<br>47<br>52%<br>46%<br>59<br>60%<br>449%<br>68<br>68<br>68<br>68<br>68<br>68<br>37<br>37<br>28<br>0  | 30<br>39<br>45<br>50<br>53<br>59<br>59<br>59<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32  |
55<br><b>52</b><br>64<br><b>62</b><br><b>65</b><br><b>73</b><br><b>66</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b> | 53<br>49<br>61<br>60<br>62<br>70<br>64<br>73<br>77<br>0<br>43<br>29<br>6   | *59<br>76<br>69<br>*81<br>89<br>75<br>*95<br>*97<br>*95<br>*97<br>*0<br>********************************   
  | 52<br>66<br>71<br>79<br>66<br>82<br>86<br>0<br>82<br>86<br>0<br>82<br>86<br>0<br>82   | *74<br>91<br>91<br>88<br>87<br>87<br>106<br>*97<br>104<br>117<br>0<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>8  | 82<br>82<br>81<br>77<br>97<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90   | 277<br>103<br>97<br>108<br>126<br>109<br>131<br>140<br>0<br>140<br>0   
   |   | 107/<br>106<br>102<br>130<br>120<br>120<br>123<br>144<br>(0.4<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4)<br>(0.4 | 120<br>112<br>112<br>1134<br>0  
  | 109<br>109<br>145<br>127<br>165<br>0   |  | 31<br>34<br>34<br>34<br>34<br>38<br>38<br>39<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30<br>30   |   
   |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>ir flow<br>2<br>vol/h   | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct+indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b><br><b>direct-indirect</b> 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36<br>40%<br>39%<br>45%<br>46%<br>0%<br>42%<br>53%<br>51%<br>0%<br>29<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>823%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825%<br>825 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34<br>x39x<br>x39x<br>x43x<br>x43x<br>x45x<br>x42x<br>x51x<br>x50x<br>x0x<br>29<br>x22x<br>x00x<br>x22x<br>x00x<br>x22x<br>x00x<br>x22x<br>x00x<br>x22x<br>x00x<br>x22x<br>x20x<br>x22x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x<br>x20x | 47<br>523<br>47<br>523<br>463<br>59<br>603<br>463<br>68<br>68<br>68<br>68<br>68<br>68<br>68<br>68<br>68<br>37<br>37<br>28<br>0   | 30<br>30<br>45<br>45<br>50<br>53<br>59<br>59<br>59<br>59<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32<br>32  |
55<br><b>52</b><br>64<br><b>62</b><br><b>62</b><br><b>73</b><br><b>66</b><br><b>76</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b> | 53<br>49<br>61<br>62<br>70<br>62<br>70<br>64<br>73<br>77<br>0<br>43<br>29<br>0<br>0  | *59<br>69<br>81<br>89<br>75<br>95<br>97<br>897<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80   
  | <b>52</b><br><b>66</b><br><b>82</b><br><b>86</b><br><b>0</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>  | <b>91</b><br><b>91</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>88</b><br><b>87</b><br><b>89</b><br><b>7</b><br><b>89</b><br><b>7</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b>80</b><br><b></b> | 68*<br>82<br>81<br>77<br>97<br>90<br>90<br>92<br>108<br>80<br>55<br>108<br>108<br>108<br>108<br>108<br>108<br>108<br>108<br>108<br>108   | 27.7<br>27.7<br>200<br>29.7<br>100<br>100<br>100<br>100<br>100<br>100<br>140<br>0<br>140<br>0<br>140<br>0<br>140<br>0<br>140<br>14   
   |   | 106<br>106<br>106<br>102<br>130<br>120<br>120<br>123<br>144<br>(0)  | 120<br>120<br>120<br>134<br>134<br>0  
  |  |  | 31<br>34<br>34<br>34<br>38<br>38<br>38<br>43<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50   | R611           76           776          
92           83           84           84           85           84           85           84           85           84           85           84  |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>vol/h<br>vol/h<br>4   | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br><b>Ave</b><br><b>Ave</b><br><b>Evap.system</b><br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant   | 36<br>40<br>39<br>45<br>46<br>46<br>53<br>51<br>0<br>29<br>29<br>23<br>0<br>34<br>34<br>34<br>34<br>34<br>34<br>36<br>39<br>39<br>39<br>39<br>39<br>39<br>39<br>39<br>39<br>39   | 34<br>\$39<br>\$0<br>\$38<br>\$43<br>\$45<br>\$0<br>\$<br>\$<br>\$<br>\$<br>\$<br>\$<br>\$<br>\$<br>\$<br>\$<br>\$<br>\$<br>\$  
   | 47<br>47<br>52<br>46<br>59<br>60<br>46<br>68<br>68<br>68<br>68<br>68<br>68<br>68<br>68<br>68<br>37<br>28<br>0<br>37<br>28<br>0<br>41<br>8<br>0<br>8<br>41<br>8   | 30<br>30<br>39<br>45<br>50<br>53<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59  |
55<br><b>*52</b><br><b>*64</b><br><b>*62</b><br><b>*62</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*66</b><br><b>*73</b><br><b>*60</b><br><b>*74</b><br><b>*60</b><br><b>*74</b><br><b>*60</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*76</b><br><b>*776</b><br><b>*776</b><br><b>*776</b><br><b>*776</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*777</b><br><b>*************</b>  | 53<br>499<br>61<br>62<br>62<br>70<br>62<br>70<br>64<br>73<br>77<br>0<br>43<br>73<br>77<br>43<br>73<br>77<br>43<br>43<br>73<br>77<br>44<br>8<br>64<br>8<br>73<br>77<br>44<br>8<br>73<br>77<br>75<br>75<br>75<br>75<br>75<br>75<br>75<br>75<br>75  | *59<br>76<br>69<br>*81<br>*97<br>*95<br>*97<br>*95<br>*97<br>*95<br>*97<br>*<br>*97<br>*<br>*97<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>*<br>*  
  | 221<br>60<br>79<br>66<br>82<br>86<br>0<br>82<br>86<br>0<br>1<br>80<br>82<br>86<br>0<br>1<br>80<br>82<br>86<br>0<br>82<br>86<br>0<br>82<br>86<br>0<br>82<br>86<br>0<br>82<br>86<br>86<br>82<br>86<br>86<br>82<br>86<br>86<br>82<br>86<br>86<br>82<br>86<br>86<br>82<br>86<br>80<br>82<br>86<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80  | *74<br>*74<br>*74<br>*91<br>*88<br>*87<br>*106<br>*97<br>104<br>*117<br>*0<br>*0<br>*0<br>*0<br>*0<br>*33<br>*51<br>*51<br>*51<br>*51<br>*51<br>*51<br>*51<br>*51  | 82<br>81<br>77.<br>97<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90  | <b>37.7.8</b><br><b>37.7.8</b><br><b>103</b><br><b>97</b><br><b>108</b><br><b>126</b><br><b>126</b><br><b>109</b><br><b>140</b><br><b>0</b><br><b>140</b><br><b>0</b><br><b>140</b><br><b>0</b><br><b>140</b><br><b>0</b><br><b>140</b><br><b>140</b><br><b>0</b>  
   |   | 106<br>107<br>106<br>106<br>100<br>120<br>120<br>120<br>122<br>122<br>122<br>124<br>122<br>122<br>122<br>122<br>122<br>122  | 1998<br>1998<br>120<br>120<br>134<br>0<br>134<br>0<br>134<br>0<br>134<br>0<br>134<br>0<br>134<br>0<br>134<br>134<br>0<br>134<br>134<br>134<br>134<br>134<br>134<br>134<br>134<br>134<br>134   
  | 109<br>1145<br>145<br>0<br>165<br>0  |  | 31<br>34<br>34<br>39<br><b>%</b> 0<br>38<br><b>%</b> 43<br>45<br><b>%</b> 43<br><b>%</b><br>45<br><b>%</b> 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| A           K           K           76    
      74           %76           %77           %76   |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>ir flow<br>2<br>vol/h<br>4<br>vol/h   | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>AveAve</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>AveAve</b><br><b>Ave</b><br><b>AveAveAveAveAveAveAveAve</b>  | 36<br>40<br>39<br>45<br>46<br>46<br>51<br>51<br>0<br>29<br>29<br>29<br>23<br>0<br>34<br>0<br>29<br>29<br>20<br>29<br>20<br>29<br>20<br>29<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20  | 34<br>\$39<br>\$39<br>\$38<br>\$43<br>\$45<br>\$45<br>\$0<br>\$29<br>\$29<br>\$29<br>\$29<br>\$22<br>\$0<br>\$29<br>\$29<br>\$29<br>\$29<br>\$29<br>\$29<br>\$29<br>\$29  
   | 47<br>47<br>52%<br>46%<br>59<br>60%<br>68<br>68<br>68<br>68<br>68<br>68<br>68<br>68<br>68<br>68  | 36<br>*39%<br>45<br>*42%<br>50<br>*53%<br>*45%<br>59<br>*59%<br>*45%<br>59<br>*59%<br>*45%<br>59<br>*59%<br>*45%<br>59<br>*59%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*45%<br>*4  | 55<br>\$52<br>64<br>8<br>62<br>65<br>73<br>8<br>65<br>76<br>76<br>76<br>76<br>880<br>8<br>80<br>8<br>8<br>44<br>8<br>8<br>44<br>8<br>8<br>44<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8<br>8  
   | 53<br><b>49</b><br>61<br><b>62</b><br>70<br><b>64</b><br><b>73</b><br><b>77</b><br><b>43</b><br><b>43</b><br><b>0</b><br><b>43</b><br><b>0</b><br><b>43</b><br><b>0</b><br><b>45</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b><br><b>1</b>   | **59<br>76<br>69<br>**81<br>****<br>****<br>****<br>****<br>****<br>****<br>***  
  | ■ 52 × 100 × 1  | 91<br>91<br>88<br>88<br>88<br>87<br>106<br>104<br>117<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80  | 268<br>82<br>82<br>81<br>77<br>97<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90  | 277.2<br>277.2<br>200<br>200<br>200<br>200<br>200<br>200<br>200<br>2   
   |   | 106<br>107<br>106<br>102<br>130<br>120<br>120<br>123<br>144<br>123<br>144<br>120<br>124<br>123<br>124<br>123<br>124<br>124<br>125<br>124<br>125<br>124<br>125<br>125<br>125<br>125<br>125<br>125<br>125<br>125<br>125<br>125  | 120<br>120<br>120<br>120<br>120<br>134<br>0<br>134<br>0<br>134<br>0<br>134<br>0<br>134<br>0<br>134<br>0<br>134<br>0<br>134<br>134<br>0<br>134<br>134<br>0<br>134<br>134<br>134<br>134<br>134<br>134<br>134<br>134<br>134<br>134   
  | 109<br>1145<br>1445<br>1445<br>165<br>0<br>165<br>0  |  | 31<br>2000<br>34<br>34<br>39<br>00<br>00<br>00<br>00<br>00<br>00<br>00<br>00<br>00<br>0  | A         A           A         A           76         A           76         A           92         B           82         B           803%         103           103         A           852%         A           53         0  
   |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>ir flow<br>2<br>vol/h<br>4<br>vol/h<br>6  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct-indirect<br>direct-indirect<br>www.max<br>Ave<br>www.max<br>Evap.system<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant  | 36<br>403<br>39<br>39<br>45<br>46<br>46<br>51<br>0<br>29<br>29<br>29<br>29<br>29<br>29<br>29<br>29<br>29<br>29   | 34<br>395<br>395<br>385<br>4385<br>4435<br>4455<br>4455<br>505<br>505<br>505<br>505<br>29<br>29<br>29<br>29<br>29<br>29<br>29<br>29<br>29<br>29   
   | 47<br>47<br>52<br>47<br>59<br>860<br>860<br>860<br>860<br>860<br>860<br>860<br>860   | 36<br>39<br>45<br>50<br>50<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59  | 55<br>\$52<br>64<br>862<br>862<br>865<br>873<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80   
   | 53<br>49%<br>61<br>62<br>860%<br>62<br>870%<br>864%<br>73<br>877%<br>864%<br>73<br>877%<br>864%<br>73<br>877%<br>864%<br>73<br>877%<br>864%<br>877%<br>864%<br>877%<br>864%<br>877%<br>864%<br>877%<br>864%<br>877%<br>864%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%<br>877%  | **59:           **59:           76           ****           *****           *****           ******           ******           *******           **************           ************************************  
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   | **************************************  | 106<br>106<br>106<br>106<br>106<br>120<br>120<br>120<br>120<br>120<br>120<br>120<br>120<br>120<br>120   | 1993<br>1993<br>120<br>112<br>112<br>112<br>112<br>112<br>112<br>112<br>112<br>112  
  | 109<br>145<br>145<br>165<br>0<br>165<br>0  |  | 31<br>34<br>34<br>34<br>39<br>39<br>439<br>439<br>439<br>439<br>439<br>439   | Ave           82           82           82           82           83           103           **52%           Ave           *29%           53           0           \$69%  
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| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>ir flow<br>2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h   | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect<br>Minect+indirect+indirect<br>Minect+indire  | 36<br>40<br>39<br>45<br>46<br>46<br>42<br>51<br>0<br>29<br>42<br>0<br>34<br>0<br>42<br>0<br>34<br>0<br>42<br>0<br>34<br>0<br>34<br>0<br>34<br>0<br>34<br>0<br>34<br>0<br>34<br>0<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35.  | 34<br>39%<br>38%<br>43%<br>443%<br>443%<br>445%<br>842%<br>53%<br>842%<br>842%<br>842%<br>842%<br>842%<br>842%<br>842%<br>842   
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   | 53<br>53<br>61<br>62<br>705<br>864<br>864<br>864<br>864<br>864<br>864<br>864<br>864<br>864<br>864  |
**59%<br>76<br>69<br>841%<br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>89<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>1010</b><br>80<br><b>100</b><br>80<br><b>100</b><br>80<br><b>100</b><br>80<br><b>100</b><br>80<br><b>100</b><br>80<br><b>100</b><br>80<br><b>10010010010010010010010</b> | ■<br>52 × 50 × 50 × 50 × 50 × 50 × 50 × 50 ×  | *74 ¥<br>91<br>91<br>88<br>88<br>87<br>97<br>104<br>104<br>4117,<br>0<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>8   | 68x           68x           82           81           77/           97           90           90           90           91           92           92           92           92           93           93           94           95           95           92           93           93           94           95           95           96           97           90           90           91           92           93           93           94           95           95           95           95          
95           95           95           95           95           95           95           95           95           95           95           95           95           95 | 3772     3772     3772     3772     3708     371     103     104     109     109     1311     140     0     3     313     140     0     3     31     4     3     3     4     3   | *831<br>*831<br>*831<br>*831<br>*831<br>*831<br>*831<br>*831  | 8861<br>8861<br>106<br>106<br>130<br>120<br>120<br>120<br>120<br>1223<br>144<br>1423<br>144<br>144<br>144<br>144<br>144<br>144<br>144<br>144<br>144<br>14   | 120<br>112<br>112<br>112<br>112<br>112<br>112<br>112<br>112<br>112  
  | 109<br>109<br>145<br>145<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>165<br>0<br>165<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>0<br>165<br>165<br>165<br>165<br>165<br>165<br>165<br>165<br>165<br>165  |  | 31<br>34<br>34<br>339<br>439<br>439<br>439<br>445<br>45<br>45<br>45<br>45<br>45<br>45<br>45<br>45<br>45<br>45<br>45<br>45  
   | A         A           A         A           A         A           B2         A           B2         A           B3         A           B3         A           B2         A           B3         B           B4         B           B4         B           B4         B           B5         B |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>with a set<br>direct+indirect<br>direct+indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>direct-indirect<br>dire   | 36<br>40<br>39<br>45<br>46<br>0<br>45<br>53<br>53<br>53<br>53<br>29<br>29<br>29<br>29<br>29<br>23<br>0<br>42<br>53<br>53<br>53<br>42<br>53<br>53<br>42<br>53<br>53<br>42<br>53<br>53<br>42<br>53<br>53<br>42<br>53<br>53<br>44<br>53<br>53<br>53<br>53<br>53<br>54<br>53<br>54<br>53<br>54<br>53<br>54<br>54<br>54<br>54<br>54<br>54<br>54<br>54<br>54<br>54   | 34<br>399<br>399<br>399<br>399<br>399<br>399<br>399<br>3  
   | 28<br>0<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37  | 36<br>39<br>39<br>45<br>50<br>50<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59<br>59  | 55<br>55<br>52<br>64<br>64<br>65<br>73<br>65<br>73<br>663<br>76<br>8669<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80  
   | 53<br>549%<br>61<br>860%<br>860%<br>864%<br>73<br>877%<br>864%<br>877%<br>877%<br>877%<br>877%<br>843%<br>877%<br>857%<br>857%<br>857%<br>857%   | **59%<br>**59%<br>**57%<br>**57%<br>**57%<br>**57%<br>**57%<br>**57%<br>**57%<br>**57%   
  | ■ 52<br>■ 66<br>■ 79<br>■ 66<br>■ 79<br>■ 66<br>■ 79<br>■ 66<br>■ 82<br>■ 86<br>■ 0<br>■ 86<br>■ 0<br>■ 82<br>■ 86<br>■ 0<br>■ 82<br>■ 86<br>■ 0<br>■ 82<br>■ 86<br>■ 0<br>■ 82<br>■ 86<br>■ 86<br>■ 82<br>■ 86<br>■ 82<br>■ 86<br>■ 86 | *74 ¥<br>91<br>91<br>88<br>88<br>87<br>87<br>104<br>4117/<br>40<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80  | 268<br>82<br>82<br>81<br>77<br>97<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90<br>90  | 377.4<br>377.4<br>377.4<br>397<br>397<br>109<br>126<br>397<br>109<br>109<br>109<br>109<br>109<br>109<br>109<br>109   | 2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>2000<br>200   
   | 8861<br>8861<br>106<br>106<br>130<br>120<br>130<br>120<br>120<br>130<br>120<br>120<br>144<br>144<br>144<br>144<br>144<br>144<br>144<br>144<br>144<br>14   | 1122<br>1122<br>1122<br>1123<br>114<br>112<br>114<br>0<br>114<br>0<br>114<br>0<br>114<br>0<br>114<br>0<br>114<br>112<br>112<br>112<br>112<br>112<br>112<br>112<br>112<br>112   | 109<br>109<br>145<br>145<br>165<br>0<br>80<br>80<br>80<br>80<br>80<br>126  
   |  | 31<br>34<br>34<br>39<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50<br>50   | 8           76           76           74           76           82           92           82           103           **52%           53           0           %69%           0           82           0           869%           0  |  |
| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h  | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>direct+indirect<br>www.www.www.<br>Ave<br>www.www.<br>Evap.system<br>ind.+Cool.plant<br>cool.plant only<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant<br>cool.plant only<br>ind.+Cool. plant<br>cool.plant only   | 36<br>40<br>39<br>45<br>46<br>53<br>53<br>53<br>53<br>53<br>53<br>53<br>53<br>53<br>53   | 34<br>39<br>38<br>38<br>38<br>433<br>445<br>550<br>445<br>550<br>50<br>30<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>8  
   | 28<br>0<br>47<br>852%<br>846%<br>59<br>866%<br>866%<br>866%<br>866%<br>866%<br>866%<br>866%<br>866   | 36<br>39%<br>45<br>50<br>50%<br>50%<br>50%<br>50%<br>50%<br>50%<br>50%  | 55<br>55<br>52<br>64<br>862<br>862<br>862<br>866<br>866<br>866<br>866<br>866   
   | 29<br>0<br>x49%<br>61<br>x60%<br>62<br>x70%<br>x64%<br>x73<br>x77%<br>x64%<br>x64%<br>x64%<br>x64%<br>x64%<br>x64%<br>x64%<br>x64  | **59:           **59:           76           69           **89:           **89:           **90:           **97:           **97:           **97:           **97:           **97:           **97:           **97:           **097:           **097:           **097:           **097:           **097:           **097:           **097:           **097:           **001:           **001:           **001:           **001:           **001:           **001:  
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   | 28<br>0<br>247<br>252%<br>29<br>260%<br>29<br>28<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>28<br>0<br>37<br>28<br>0<br>28<br>0<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>0<br>37<br>37<br>28<br>37<br>37<br>28<br>37<br>37<br>28<br>37<br>37<br>28<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37<br>37   | 36<br>39:<br>45<br>50<br>50<br>59<br>59<br>32:<br>32:<br>32:<br>32:<br>32:<br>32:<br>32:<br>32:   | 55<br>55<br>52<br>64<br>55<br>64<br>55<br>76<br>78<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>80<br>8  
   | 53<br>53<br>61<br>869<br>62<br>864<br>864<br>73<br>77<br>864<br>87<br>8<br>8<br>43<br>8<br>8<br>43<br>8<br>8<br>43<br>8<br>8<br>9<br>0<br>8<br>43<br>8<br>8<br>9<br>0<br>8<br>43<br>8<br>8<br>9<br>0<br>8<br>43<br>8<br>8<br>9<br>0<br>8<br>43<br>8<br>8<br>43<br>8<br>8<br>43<br>8<br>61<br>9<br>8<br>61<br>9<br>8<br>62<br>8<br>61<br>9<br>8<br>62<br>8<br>64<br>8<br>62<br>8<br>64<br>8<br>8<br>62<br>8<br>70<br>8<br>62<br>8<br>70<br>8<br>70<br>8<br>70<br>8<br>70<br>8<br>70<br>8<br>70<br>8<br>70<br>8<br>7   | x          
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| vol/h<br>6<br>vol/h<br>8<br>vol/h<br>ir flow<br>2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h   | direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>none<br>direct<br>indirect<br>direct+indirect<br>direct+indirect<br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>Ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>ave</b><br><b>a</b> 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	Solar ga	ins S*Aglaz/Aroom	T	Section 2	********	0	.05	all	CICC	uica	li ene	T GY	KYVI	0	.15			(	National State	 	
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1		Inertia	H	igh	L L	wc	н	igh	L	ow	Ĥ	iqh	L	ow -	Н	iah	L	ow		* `	
8		Orientation	Ē	W	Е	W	Е	Ŵ	E	W	Е	ĬW -	Е	W	E	W	ε	W			
÷ .	Air flow	Evap.system							With	out c	ooling	plant			<b>.</b>			<u>.</u>	min	Ave	max
		none		201002		1999		<b>***</b>						100		1	- 207	CONT.			
	2	direct	<u>%</u> 17_	<u></u> 16	1000			6980											16		
	vo!/h	indirect	<u>%</u> 18	<b>&amp;17</b> @															\$175		
		direct+indirect	<u>歳</u> 1 <b>7</b> 歳	<b>&amp;17</b>	<b>%17</b> @	<b>16</b> %		Q. 3				<b>868</b>							168		
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۰.	4	direct	24	24	§24	<b>\$24</b>	\$ <b>31</b> }	\$3. <b>1</b> }}										3444	24	$\hat{\mathbf{x}}_{i} \rightarrow \hat{\boldsymbol{\omega}}_{i}$	
1.5	vol/h	indirect	28	28	×28	<u>\$</u> 27	<b>35</b>	§35)	STORAGE ST			<b>MARK</b>	<b>MARSH</b>				1		27	No See	
1.14		direct+indirect	25	25	26	25	<b>%33</b> %	¥32	¥34)	AND ALCON	<b>%38</b>	10000			100				25		
14	~	none	<u>{</u> 42)	<u>(42)</u>	<u></u> 43		×51	<u>\$51</u>		10018196		1000		STRAIL					¥41¥		
A.	0	direct	32	32	32	×31¥	<u>8</u> 418	<u>8</u> 41)	42		<b>48</b>	47		ADDAG		ACCE IN COM		ACCE IN CONTRACT	31	<b>44</b> %	
3.0	VOI/11	indirect	39	38	39	\$378	<u></u>	<u>847</u>	& <b>49</b> &	MILLINE:	§55	<b>STAND</b>	<b>AND ON</b>	10000	ality and	1000			37		
, · · :		direct+indirect	\$J4) ***	%.J.J.%	35	33	44	43	×45×	<u></u>	₩51@	×49×	\$50	STERN HERE	860×	°58∝		100	<u>"</u> 33",	∛46≎	
	ρ	direct	<u>#23</u>	2 <b>4</b> %	<b>804</b> ⊗	20	<u>%03</u> %	8038 850					10000			2.3			<u>≋52</u> ∦		
1	vol/h	indirect	<u>⊿0</u>	40	40	× 398	61	<u>%0c%</u>	802%	N.FO	1%29%	1×288	×59.		10	<u> 1</u>			39	.54	
	.5///	direct+indirect	43%	\$42%	×22×	42	55	54	56	X 338	64	1×41%	62	60	74	72	70		4/	03	
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		Δνο	32	31	822×	*21×	22 @/0%	*A00	LL.		24	23	82.45	323	29	. 29	20		10		1
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	Air flow	Evap.system	NUMPERATIN	1 Constanting	8-2-0-58-28-28	segurate	eograan	1.000 OF BRIDE	W if	h cor	ling n	lant	<b>SERVICE</b>		<u>. 1999 - 19</u>		10000		min	Aug	mox
	2	ind +Cool, plant	<b>%17</b> &	<b>%16</b> %	17	16	22	22	×22×	1 <b>©21</b> ≫	8258				15.3			antesanto.	946°	AVE NO 21	max
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. itt	4	ind +Cool. plant	§25§	§25§	§25§	§24§	§33§	§32\$	34	32	<b>%38</b> %	36	×38×	¥35×	45	44	45	10000000000000000000000000000000000000	×24	35	20082092
1. Car	vol/h	cool.plant only	\$13¢	%13ø	<b>%14</b> %	14	<b>%19</b> %	<u>%19</u> *	22	22	27	26	27	26	34	¥34%	\$34	Call Harry	<u>813</u>	23	STREET.
1.9	6	ind.+Cool.plant	<b>∦34</b> ∦	¥34¥	<b>%33</b> %	<b>∦32</b> ∦	¥43	<u></u> 43)	<u>\$</u> 43	×42§	<b>%50</b> %	48	50	46	<u>59</u> %	58	58	855€	× 32×	46	359
	vol/h	cool.plant only	<b>%17</b> #	#17#	<b>%18</b> %	§18¥	<b>%24</b> %	<u></u>	<b>%27</b>	28	<u>832</u> *	*32*	33	×32×	41	41	∛42្	£418	<u>*17</u>	29	42
	8	ind.+Cool. plant	<b>《44</b> 》	<b>∦43</b> ≬	§42≬	<b>%41</b> %	∛54⊗	<b>∛53</b> ≬	<b>∛53</b> ≋	<b>**52</b> §	<u>%</u> 62	§60§	61	57	73	71	71	67	<b>(41</b> )	57	73
	vol/h	cool plant only	<b>%23</b> <u>%</u>	<b>∦22</b> ∦	§23≬	¥23×	<b>⊚30</b> ⊗	<b>⊗30</b> ∛	<b>∂33</b> €	34	¥40×	∜39∦	40	39	49	49	50	49	22	36	50
1		min	×12®	12*	<u>%12</u> %	§128	% <b>17</b> %	<u>17</u>	17	17	` <b>21</b> ∖;	\$20 <u>°</u>	21	20	26	25	25	25	12		
		Ave	,23	«Z3»	§23§	22	%30 ×	<u>~30</u>	31	31	37	36	36	835≙	45	44	44			33	
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						*							、								
	Air flow	Evap system			· · ·	<u>\</u>			With		eas g	niant	1						min	A. 10	
		none	STATUTE CONTRACT	<b>MATHORN</b>	10014009	10011000	<i>indiana</i>	<b>WORKSON</b>	distances.	ABRINE	Committee T	2010	STREET, ST	1000	8.2018	- 15 - 14	N		2002000000	Ave	max
Jack	2	direct	<b>%18</b>	M17.W	1000000	AUDIOUS	APPLICATION IN CONTRACT	20001000	ADDINIOUT	Successor	ANNA ANNA	10040339	10001000		Stantes.	1.00	12001010	Same and	A&16%		
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AL COL		direct+indirect	¥20¥	<b>%19</b> %	¥20*	M18	1051063	000000	10000000	Manage.	NUMBER OF	ANTIAL C	AND NOT	SUDAMON S	SHARING STREET	AND IN THE REAL PROPERTY OF	90394096	SHOREGON.	%18%	122004-1228	2003 2007
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1	vol/h	indirect	21	20	¥22	19	¥21	×21×	1001780	1000	10000		96000					- 16 - 14 - 14 - 14 - 14 - 14 - 14 - 14	13		
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	6	direct	33	32	<b>%34</b> %	<b>%30</b>	<b>46</b> %	£45¥	<b>\$43</b> %	1 - G	<b>%56</b> %	§53§							30	47	
:	vol/h	indirect	28	27	31	<b>26</b>	§33§	×32×	<b>%33</b> %	k.	<b>%34</b>								26		
		direct+indirect	∉38≰	#37#	40	36	51	49	§50¥	¥46¥	<b>≋64</b> ≋	×59×	<b>≬65</b> ∦		⊚7.1⊗	67		X	36	ି 54ି	
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	o vol/b	indiract	36	3/	40	8308 22	54	¥52%	%51∰.	SEALURE .	<b>%67</b> <i>%</i>	§62	<u>%66</u> %		\$7.7 <i>@</i>	*		1. A	36	<b>⊗55</b> ≰	
	VUIT	direct+indirect	CC WAAW	33	00 ×20×	33	43	41	<u>644</u>	%30%	%40% 7⊑	<b>42</b>			47				33	¥418	
	Medi <b>Mi</b> berticien		10 C 10 10	M.+0%	※ <b>・</b> 」の第	42	_09	07	09	80043 800 m	10	10	10 C 200	%CO%	\$C0%	\$81¥	100 A 100	and the second second	×42 ×	63	ve:
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	Air flow	Evap.system	-senterings.	7-22-4466-0		-outridig-	1-dependence	warachini.	Wit	h coo	ling p	ant	NAME AND A DESCRIPTION OF A DESCRIPTIONO	YANNAYAN	0000000	-	à church ann an thai	34469496	min	Ave	max
N.	2	ind.+Cool.plant	<u>%</u> 16§	¥15¥	17	15	21	20	<b>20</b>	<b>%18</b>	§20ø						<i></i>		<u>13</u> *	<u>%</u> 17%	
1.0	vol/h	cool plant only	386 1 387	.08 D ave		0	0	<u> </u>	380 <b>D</b> 980	110000	100 11 100	AND		International and	_				NP5 4	1911 344	

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--|---|---|
| 6              | direct  | 33   | 32   
   
   | <b>%34</b> %  | <b>%30</b> %  
   
   | <b>%46</b> %  
   | <b>《45</b> 》   | <b>\$43</b> }  | 1 - M   | ¥56¥  
   
   | §53§  |   | -   |   |  |  |  | 30   
   | 47  |   |
| vol/h          | indirect  | 28   | 27   
   
   | 31  | 26  
   
   | §33∦  
   | ×32×   | <b>%33</b> %   | 2   | <b>%34</b>  
   
   |   |   |   |   |  |  |  | 26   
   |   |   |
|                | direct+indirect   | ∉38≰   | \$37   
   
   | 40  | 36  
   
   | 51  
   | 49   | §50 §  | ×46×  | <b>≋64</b> ∛  
   
   | ×59×  | \$65×   | -   | ⊚7.1⊚   | 67   |  |  | 36   
   | 54  |   |
|                | none  | <b>#0</b> #  | <b>0</b> %   
   
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   |   |   | 112 . J   |   |  |  |  | £0%  
   |   |   |
| 8              | direct  | 38   | 37   
   
   | 40  | <b>36</b>   
   
   | 54  
   | ¥52%   | §518   | <b>1000000</b>  | <b>《67</b> 》  
   
   | §62   | <u>%66</u> %  |   | .7.7.   | ·  |  | 1 64   | 36   
   | 255≰  |   |
| vol/h          | indirect  | 35   | 33   
   
   | 38  | 33  
   
   | 43  
   | 41   | <b>844</b>   | <b>%38</b> %  | 46  
   
   | 42  | 1000  | alerant.  | 478   |  | 100  | 1  | 33   
   | ¥418  |   |
|                | direct+indirect   | ¥44¥   | ×43  
   
   | <u></u> 46 🛛  | 42  
   
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   | 57   | 59   | <b>≋54</b> ≶  | 75  
   
   | 70  | \$7.72  | ×65×  | <b>85</b>   | ¥81Ø   | <b>83</b> %  | 1.000  | 42   
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| Air flow       | Evap.system   |  |  
   
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   |  | Wit  | h coo   | ling p  
   
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| 2              | ind.+Cool. plant  | <u>@16</u> @   | <u>%15</u>   
   
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   | 21  
   | 20   | <u>20</u> %  | <b>%18</b> }  | §20§  
   
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   | 3   |   |
| 4              | ind.+Cool. plant  | §22§   | <b>∦21</b> ∦   
   
   | <b>24</b>   | <b>\$22</b>   
   
   | 31  
   | <b>. 29</b>  | 33   | 30  | \ <b>39</b>   
   
   | 36  | 42  | ¥35¥  | 44  | 42   | ¥43  |  | 215  
   | 33  |   |
| vol/h          | cool.plant only   | \$\$0 <u>\$</u>  | 2022   
   
   | <b>#0</b> #   | <b>20</b> 2   
   
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| 6              | ind.+Cool.plant   | \$27   | §26§   
   
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   | ×35×   | .40  | 37  | 47  
   
   | <u></u> 43§   | 53  | 45  | 55  | 52   | 60   | *518   | 26   
   | 42  | ×60×  |
| vol/h          | cool.plant only   | #0#  | #0#  
   
   | <b>%0</b> *   | <b>20</b> 2   
   
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   | 0   | <b>%0</b> %   |
| 8              | ind.+Cool.plant   | <u>*33</u>   | <u>∦31</u> ®   
   
   | <u>36</u>   | ×32 g   
   
   | ×43   
   | <u>41</u>  | <u></u>  | 43  | <b>*54</b>  
   
   | <u>49</u>   | 61  | 53  | 63  | 59 .   | 71   | 61   | §31%   
   | 49  | 71  |
| vol/h          | cool.plant only   | <b>#0</b> #  | #0#  
   
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| 201-114        | Ave Maint   | §12§   | §12§   
   
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|                | alle max (the second  | ×33×   | \$ <b>31</b> \$  
   
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   | Weighter  | North Carl  | In the  | 130   | 0  | 1. 1.  | Bar All in   | Side alla  
   | 28 al 1   | . < .   |
|                | 6<br>vol/h<br>8<br>vol/h<br><u>Air flow</u><br>2<br>vol/h<br>4<br>vol/h<br>6<br>vol/h<br>8<br>vol/h | 6 direct<br>indirect<br>direct+indirect<br>0 direct+indirect<br>0 direct<br>0 direct | 6       direct       33         vol/h       indirect       28         direct+indirect       28         direct+indirect       38         vol/h       indirect       35         direct-indirect       35         direct-indirect       35         direct-indirect       444         min       0         Ave       21         max       0         Ave       21         max       0         Ave       21         max       0         Ave       0         2       ind-tCool.plant         vol/h       cool.plant only       0         4       ind.+Cool.plant       227         vol/h       cool.plant only       0         8       ind.+Cool.plant       33         0       min       33 </td <td>6         direct         33         32           indirect         28         27           direct+indirect         28         27           direct+indirect         28         27           direct         38         37           none         0.         0.           8         direct         38         37           vol/h         indirect         35         33           direct+indirect         344         43%           min         0.         0.         0.           Air flow         Evap.system         16.         15.%           vol/h         cool.plant only         0.         0.           4         ind.+Cool. plant         22.         21.21           wol/h         cool.plant only         0.%         0.%           4         ind.+Cool. plant         22.%         21.8           vol/h         cool.plant only         0.%         0.%           6         ind.+Cool. plant         27.%         26.8           vol/h         cool.plant only         0.%         0.%         0.%           8         ind.+Cool. plant         83.3%         31.%         0.%         0.%</td> <td>6         direct         33         32         334           indirect         28         27         31           direct+indirect         28         27         31           direct+indirect         28         27         31           direct+indirect         38         \$37         40           none         0         0         0         0           8         direct         38         37         40           indirect         38         37         40           indirect         35         33         38           direct+indirect         \$44         \$443         \$469           wol/h         indirect-indirect         \$44         \$443           Ave         21         21         \$22           Ar flow         Evap.system         \$2         \$21         \$22           2         ind.+Cool.plant         \$16         \$15         \$17           vol/h         cool.plant only         \$0         \$0         \$0           4         ind.+Cool.plant         \$27         \$26         \$30           vol/h         cool.plant only         \$0         \$0         \$0           <t< td=""><td>6         direct         33         32         344         30           vol/h         indirect         28         27         31         226           direct+indirect         28         27         31         226           direct+indirect         28         27         31         226           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indirect         35         33         38         33           direct+indirect         444         843         468         42           min         0         0         0         0         0           Ar flow         Evap.system         17         15         17         15           vol/h         cool.plant only         0         0         0         0           4         ind.+Cool.plant         822         821         224         822         824         822           vol/h         cool.plant only         0         0         0         0         0         0         0         0         0         0         0         <td< td=""><td>6         direct         33         32         34         30         46           vol/h         indirect         28         27         31         26         333           direct+indirect         28         27         31         26         333           direct+indirect         28         27         31         26         333           direct+indirect         28       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   33         34         34         34         34         34         34         34         34         34         34         34         34         34         34         34         34         34         34         33         33         33         33         33         33         33         34         34</td><td>6         direct         33         32         34         30         46         43         44         46         46         46         45         46         46         45         46</td><td>6<br/>vol/h         direct         33         32         34         30         46         45         43         100         65         53         45         100           direct         28         27         31         26         33         32         33         100         34         100</td><td>6         direct         33         32         34         30         46         45         43         Max         56         53         55         63         53         55         63         53         55         63         53         55         63         53         55         63         53         55         65         73         71         67           0         direct+indirect         238         87         40         36         51         49         \$50         468         664         59         85         71         67           none         00&lt;</td><td>6       direct       33       32       34       30       46       45       43       56       53       55</td><td>6       direct       33       32       34       30       468       45       443       56       53       56</td><td>6         direct         33         32         34         30         464         455         443         566         53         53         55         65         53         55         65         53         55         65         53         55</td><td>6       direct       33       32       344       30       465       443       104       566       53       36       100       100       30       47         101/h       indirect       28       27       31       266       33       32       33       100       34       100       100       100       26       30       47         direct+indirect       738       87       40       36       51       49       508       468       464       59       658       100       100       26       36       54         0       direct       38       37       40       36       54       452       151       444       38       466       422       56       100</td></td></td<></td></t<> | 6         direct         33         32         344         30           vol/h         indirect         28         27         31         226           direct+indirect         28         27         31         226           direct+indirect         28         27         31         226           direct+indirect         286         87*         40         36           wol/h         indirect         38         37         40         36           wol/h         indirect         35         33         38         33           direct+indirect         444         843         468         42           min         0         0         0         0         0           Ar flow         Evap.system         17         15         17         15           vol/h         cool.plant only         0         0         0         0           4         ind.+Cool.plant         822         821         224         822         824         822           vol/h         cool.plant only         0         0         0         0         0         0         0         0         0         0         0 <td< td=""><td>6         direct         33         32         34         30         46           vol/h         indirect         28         27         31         26         333           direct+indirect         28         27         31         26         333           direct+indirect         28         27         31         26         333           direct+indirect         28         27         31         26         333           wol/h         indirect         38         37         40         36         51           %         direct         35         33         38         33         43           direct+indirect         \$443         \$468         42         59           min         00         0         0         0         0         0           Are         21         21         22         20         28           max         max         0         0         0         0           4r flow         Evap.system        </td><td>6         direct         33         32         34         30         46         45           vol/h       
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34         36         34         36         34         36         36         36         36         36         36         36         36         36         36         36         36         36 | 6<br>vol/h         direct         33         32         34         30         46         45         43         100         56         53           indirect         28         27         31         26         333         32         33         100         34         100         34         100         34         100         34         100         34         100         34         100         34         100         34         100         34         100         34         100         34         100         34         100         34         100< | 6         direct         33         32         34         30         46         43         43         56         53         56           vol/h         indirect         28         27         31         26         33         32         33         34         33         33         33         33         33         33         34         34         34         34         34         34         34         34         34         34         34         34         34         34         34         34         34         34         33         33         33         33         33         33         33         34         34 | 6         direct         33         32         34         30         46         43         44         46         46         46         45         46         46         45         46 | 6<br>vol/h         direct         33         32         34         30         46         45         43         100         65         53         45         100           direct         28         27         31         26         33         32         33         100         34         100 | 6         direct         33         32         34         30         46         45         43         Max         56         53         55         63         53         55         63         53         55         63         53         55         63         53         55         63         53         55         65         73         71         67           0         direct+indirect         238         87         40         36         51         49         \$50         468         664         59         85         71         67           none         00< | 6       direct       33       32       34       30       46       45       43       56       53       55 | 6       direct       33       32       34       30       468       45       443       56       53       56 | 6         direct         33         32         34         30         464         455         443         566         53         53         55         65         53         55         65         53         55         65         53         55 | 6       direct       33       32       344       30       465       443       104       566       53       36       100       100       30       47         101/h       indirect       28       27       31       266       33       32       33       100       34       100       100       100       26       30       47         direct+indirect       738       87       40       36       51       49       508       468       464       59       658       100       100       26       36       54         0       direct       38       37       40       36       54       452       151       444       38       466       422       56       100       100       100       100      
100       100 |

and the second 1 & W Hall

# Chapter C Slab cooling system with water



#### 1 Introduction

The main purpose of the tool for slab cooling systems with water is to provide the designer with a simple means of evaluating the suitability of the technology in terms of cooling capacity in the early stages of design.

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# 2 Parameters

This tool gives an estimate of the cooling that the system is able to remove from the conditioned space as a function of the known indoor air temperature, the outside wet-bulb and the outdoor dry-bulb air temperatures. It provides the designer with mean expected cooling capacity of the system. (Note that a cooling tower is assumed to provide cooling to the slab.)

The charts in Section 3 give the specific cooling capacity of the system for the usual ranges of the three input values for the model. The lines shown are the best fit correlation and carry an average uncertainty of 7.86%.

The absorbed heat flux by the upper surface the slab and by the cooling system (Figure 1) can be evaluated by the following expression:

 $q_{\text{absorbed heat}} = q_{\text{tdb}} + q_{\text{twb}}$ 

where  $q_{tdb}$  and  $q_{twb}$  are given in Figure 2.



Figure 1 Slab construction

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# 3 Design charts





Figure 2 Cooling removed by slab cooling systems with water

# 4 Accuracy

Figure 3 shows the absorbed heat flux for an indoor temperature of 24 °C obtained by this simplified tool and by the detailed design tool described in IEA Annex 28 Report *Detailed design tools for low energy cooling technologies*. Cooling increases when the ratio Twb/Tdb is lowest, ie when the outdoor air is drier, because a cooling tower is assumed to be the cooling source.



Figure 3 Detailed tool and simplified tool values

# Chapter D

# Night cooling ventilation in UK commercial buildings

Developed	by:
Name:	Maria Kolokotroni
Organisatio	n: Building Research
	Establishment Ltd
Address;	Watford, WD2 7JR, UK
Phone:	+44 1923 664000
Fax:	+44 1923 664796
E-mail:	Current contact:
	palmerj@bre:co:uk

#### 1 Introduction

It has been established over recent years through research work and built examples that night ventilation is an effective low energy cooling technique for appropriately designed modern buildings, especially in climates similar to that of the UK with relatively low peak summer temperatures during the day and medium to large diurnal temperature differences. Such climates permit the thermal mass of the building to use the cool night air to discard the heat absorhed during the day. Therefore cooling using night ventilation is particularly suited to office buildings, which are usually unoccupied during the night so that relatively high air flows can be used to provide maximum cooling effect. Buildings using night ventilation for cooling have been evaluated in the UK and encouraging results are reported<sup>[12,3]</sup>.

In order to belp designers to explore the application of night ventilation cooling in the early design stage, pre-design computer tools have been developed<sup>[4,5]</sup>. These are based on various simplified theoretical and empirical models and typical design days or user defined weather (typically for one week). Such tools provide the opportunity to explore quickly various scenarios in terms of internal heat gaius, ventilation rates, occupancy patterns and external temperatures. They predict peak temperatures or daily temperature profiles and they can give an indication of expected energy benefits by extrapolation of data to the whole cooling period. One such userfriendly tool is Nitecool, which is now available from the BRE website (http://projects.bre.co.uk/refurb/nitecool). This is for use at the early stages of design development when the basic form and organisation of the building is being evolved. User input is limited to a few key variables such as glazing ratio, orientation, internal gains, ventilation rates and thermal mass. This technique allows the designer to explore rapidly the effects of a range of design variables. Nitecool can be used not only to assess the potential for night cooling, but also to consider appropriate ventilation strategies for refurbishment.

The design charts and tables included in this tool have been derived from simulating the performance of a 'typical' office module throughout the summer period using full weather data and a finite difference thermal simulation model. In this way, more detailed analysis is provided but only for the SE England climate considered. In addition, the potential energy savings have been derived by comparing the hourly temperatures achieved in the night-cooled office with an identical office controlled to the same conditions by an active cooling system.

This tool gives the maximum temperature and the fan hours operation for night cooling on the basis of the following parameters:

- Climate
- Building thermal inertia
- Window solar protection

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#### • Internal gains

Plant

These are defined in Section 2. The results from the simulations are presented in the form of design charts (Section 3). Example calculations are included to illustrate the intended method of use.

#### Thermal model and weather data

The two constructions and the control strategy were programmed into the thermal model APACHE and simulations performed for the four summer months from June to September. For each simulation temperature, frequency distributions and related energy data have been generated for those months.

### 2 Parameters

#### 2.1 Climate

Heathrow weather data were used for the simulations. They are characterised by a peak temperature of 29 °C and solar radiation values typical for SE England.

#### 2.1.1 Temperature







### 2.2 Building thermal inertia

The building model is based on a typical cellular office with dimensions 10 m width, 6 m depth and 3 m floor-to-ceiling height. It is positioned in the middle of a row of offices on the middle floor of a three-storey office block and has  $0.2 \text{ m}^2$  glazing per m<sup>2</sup> of floor area. This module has been derived as a suitable office for night cooling through previous research work<sup>[6]</sup>. A thermally heavyweight and a thermally lightweight construction are simulated as the two extremes for creating the curves. In both constructions the thermal conductivity of the external wall is kept similar with 100 mm mineral fibre insulation, while the internal partitions, floor and ceilings are assumed to be adjacent to spaces with similar temperatures to the simulated space. For the heavyweight construction the required exposed thermal mass is provided by

75 mm exposed concréte on the ceiling and 100 mm plastered concrete block on the external wall. In contrast, the reference (internally lightweight) module has a false ceiling and 400 mm air gap underneath a 150 mm concrete slab. The external wall is insulated framed construction with lightweight plaster on the internal face. In both cases the floor is carpeted and the internal partitions are lightweight plasterboard.

#### 2.3 Window solar protection

Estimated solar gains need to be added to the internal gains to use the design charts. Values have been generated for two extreme glazing types: low gain (eg reflective double glazing) and high gain (eg single clear glass). These are given in Table 1.

# 2.4 Internal gains

Occupancy is assumed between 08.00 and 18.00 h during weekdays only.

# 2.5 Plant

Day ventilation is operated to correspond with occupancy between 08.00 and 18.00 h during weekdays only.

Night ventilation is operated between 24.00 and 07.00 h. The controls are as follows based on work by BSRIA<sup>[7]</sup> which operate night cooling when all the following conditions are satisfied:

- The time is between midnight and 07.00 h
- Inside air temperature >18 °C
- Outside temperature >12 °C
- Outside air temperature < inside air temperature

#### **3** Design charts and tables

The charts and tables can be used to estimate three parameters in turn: peak temperatures, free cooling provided and fan energy required.

#### 3.1 Peak temperatures

Figure 1 shows the peak day internal dry resultant temperature exceeded for 30 h over the 4-month period. The temperatures are shown as a function of the following parameters:

- Combined solar and internal heat gains
- Exposed thermal mass
- Day ventilation rate
- Night ventilation rate

From Figure 1 it can be seen that the lowest temperatures are achieved in the case of high day ventilation rates and exposed thermal mass office. In general, there is a 2 °C temperature difference between the reference and the exposed thermal mass office.

It should be noted that the observed positive aspects of daytime ventilation



**Figure 1** Internal dry resultant temperatures exceeded for 30 h in reference and exposed thermal mass offices, using Heathrow weather data

are related to and are dependent on external temperatures such as those usually found in the UK and other moderate summer climates (ie peak external temperatures up to 29 °C). However, in hot climates and indeed during hot days in the UK, minimum daytime ventilation rates would be more beneficial.

#### Calculation of solar and internal gains

In order to use the graphs of Figure 1, an estimate of the likely solar and internal gains is required. Internal gains will depend on the design of the office and occupancy patterns. Typical good practice values are  $5-25 \text{ W/m}^2$  for occupants,  $5-10 \text{ W/m}^2$  for lighting and  $10-15 \text{ W/m}^2$  for IT equipment.

Solar gains are more difficult to estimate and will depend on orientation, area and type of glazing, and type and extent of solar shading. However, as a rule of thumb the values in Table 1 are provided for the case with no shading in the UK. It should be noted that solar gains would be different for different latitudes, especially lower ones where south heat gains are usually less than those from east and west. Again, as a rule of thumb, it can be assumed that solar gains are proportional to the glazing area and to the shading coefficient. The values presented in Table 1 have been derived from simulations using the reference office with the same weather and occupancy conditions as those described above.

Table 1 Predicted solar gains using Hea	athrow wea	ther data		
	Orientati	on		
	North (W/m²)	East (W/m²)	South (W/m²)	West (W/m²)
Low-gain glazing (eg reflective double glass)	7	12	20	20
High-gain glazing (eg single clear glass)	10	24	35	35

Figure 1 presents the internal dry resultant temperatures that were exceeded for 30 h in a reference office and an exposed thermal mass office using Heathrow weather data. Maximum space temperatures were predicted to be higher by about 1.5 to 2.0 °C for the reference office and 1.0 to 1.5 °C for the exposed thermal mass office. It should be noted that in mechanical systems, and in particular when high ventilation rates are utilised, fan pick-up can increase temperatures by about 0.5 to 1.0 °C.

#### 3.2 Free cooling provided

It should be noted that Figure 1 presents peak temperature reductions only. In many cases, larger reductions are achieved during other times of the occupied period especially during the morning hours, as presented schematically in Figure 2. This effect is taken into account for the calculation of total free cooling provided during occupancy hours as presented in Figure 3.

The free cooling has been quantified in terms of energy saved per unit floor area during the summer months of June to September. It is clear that the free energy provided by night ventilation is a worthwhile strategy in the exposed thermal mass office, providing between 6 and 20 kWh/m<sup>2</sup>/annum of free energy. However, there is some benefit in night ventilating a reference-type building as the free energy provided ranges between 2 and  $5 \text{ kWh/m^2/annum}$ . In the reference building, the benefits might be offset by the energy required to run a fan in mechanical systems, although night ventilation would certainly be a worthwhile strategy if it is provided by natural means.



**Figure 2** Schematic of hourly temperature in an exposed thermal mass office with and without night ventilation. Internal gains are set to  $25 \text{ W/m}^2$ , infiltration to 0.4 air changes per hour (ach) and day ventilation to 2 ach



Figure 3 Free cooling provided with night ventilation in reference and exposed thermal mass offices, using Heathrow weather data

# 3.3 Fan energy required

If the night ventilation is provided through a mechanical system, some energy is required for the fans during the night. An indication of the required energy is presented in Figure 4 in terms of fan hours run. These estimated fan hours can be multiplied by the fan power to obtain fan energy consumption as follows:

 $E_{\text{fan}} = \text{SFP} \times Q_a \times h$ 

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where:  $E_{\text{fan}} = \text{fan energy consumption (Wh/m<sup>2</sup>/annum)}$ SFP = specific fan power (W/l/s)

 $Q_a = \text{air flow rate } (1/s/m^2)$ 

h = fan run hours during summer





Figure 4 Number of fan hours to provide the free cooling predicted in Figure 3

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#### 3.4 Example calculations

Table 2 provides some example calculations for a case with internal + solar gains of 25 W/m<sup>2</sup>. It can be seen that the energy required by advanced and best practice (SFP = 0.75 to 1+) fans is only a small percentage of the free cooling provided by night ventilation. It could be a worthwhile strategy for exposed mass building when using less efficient fans, but the benefits may be offset by the fan energy consumption for the reference case and at higher ventilation rates.

Day	Night	Temp	Cooling (kWh/m²/annum)	Fan run (h)			
ventilation	ventilation	(°C)			Fan energy (kWh/m²/annum)		
(ach)	(ach)	(Fig 1)	(Fig 3)	(Fig 4)	SFP=0.75	SFP=1	SFP=2
Reference of	ffice						<u></u>
2	2	28	3	275	0.35	0.45	0.9
2	8	26.5	3.25	125	0.6	0.8	1.6
Exposed the	rmal mass offic	e					
2	2	25	11	450	0.55	0.75	1.5
2	8	24	13	315	1.5	2	4

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# **Chapter E**

# Night cooling in residential buildings

#### Developed by:

Name:	J R Millet
Organisation:	CSTB
Address:	BP 02-F-77421
	Marne-la-Vallée Cedex 02
Phone:	33.01/64688300
Fax:	33 01 64688350
E-mail:	millet@cstb.fr

#### 1 Introduction

Night cooling is introduced into the building at night by opening windows or vents. As the air circulates it comes into thermal contact with, and cools, the exposed building fabric. The stored coolness helps to limit temperature rises the following day.

With natural ventilation systems in residential buildings, the air flow is mainly due to windows being opened. Typical air change rates of between 5 and 20 air changes per hour may be achieved in residential buildings, but issues such as privacy, security and outdoor noise must be addressed. It is important with natural ventilation cooling that the designs allow for cross ventilation, with windows on each side of the building. To enable good control of the air flow rate during the night, windows should have some means of being kept open in various positions (eg half opened or completely opened). Additionally, in some cases, shutters should be designed in order to allow air flow but to provide security against robbery or protection from unwanted natural light (eg for bedrooms).

Whether the system is controlled automatically or manually, the goal is to precool the building as much as possible during night-time in order to prevent overheating the following day. During warm weather, night ventilation can always be used, but when days are cooler there can be a conflict between comfort during the night and comfort during the day. This is often the case when internal temperature swings are high, which occurs for lightweight buildings or ones with large solar gains. Air speed must also be limited so as not to cause thermal discomfort, especially at night when outdoor temperatures may be less than about 15 °C.

This tool gives the gives minimum solar protection required to limit the maximum internal temperature to specified values. The data presented have been generated using the simplified thermal model COMET where the room behaviour is represented by an RC (resistance-capacitance) network.

The parameters of climate, building thermal inertia, window solar protection, ventilation strategy and noise exposure of facades are defined in Section 2. The results from the simulations are presented in the form of design tables in Section 3.

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# 2 Parameters

# 2.1 Climate

Four different climates have been considered (F1, F2, F3, F4) with temperatures and solar radiation characteristics as detailed in Figure 1.



Figure 1 Characteristics of the four climates

# 2.2 Building thermal inertia

Five classes of thermal inertia have been included:

- TL Very heavy
- L Heavy
- ML Medium
- Le Light
- TLe Very light

They are as defined by the following table.

Iner	tia class	Ceiling or roof	Floor	External wall	Internal wall between dwellings	Internal wall in the dwelling
TL	Very heavy	Heavy	Ground inertia	Heavy	_	
ΤL	Very heavy	Heavy	Ground inertia	—	Heavy	Heavy
L	Heavy	Heavy	Heavy	Heavy	—	
L	Heavy	Heavy	Heavy	—	Heavy	Heavy
ML	Medium	Heavy	Heavy		<b></b>	
Le	Light		Heavy	_	_	
Le	Light	Heavy	—	—		
TLe	Very light		_	_	—	

#### 2.3 Window solar protection

The definition of solar protection classes is as follows :

- **PP** Permeable window protection: this kind of protection enables natural ventilation even when they are operated at night. If there are security hazards, the protection must be suitable
- **PNP** Non-permeable window protection: other types of protection with transparency less than 10%
- SPD Without any window protection but with architectural solar protection as overhangs
- SP Other cases

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The overhangs for SPD must be equal at least to  $\frac{3}{4}$  of the window height with a length equal at least to twice the window width (see Figure 2).





Figure 2 Size of overhangs for windows

# 2.4 Ventilation strategy and noise exposure of facades

Two cases of noise exposure are defined:

- **EB1** Bedroom not exposed to noise, other rooms exposed to a noise requiring an acoustic insulation less or equal to 30 dB(A)
- EB2 Other cases

Four base cases have been considered on the basis of these exposures:

- A Dwelling with cross ventilation, all rooms EB1
- **B** Dwelling without cross ventilation, all rooms EB1
- C Dwelling with cross ventilation, 35 % of windows (area-based) in EB1 situation
- D Other cases

# 3 Design tables

These tables define the minimum solar protection required to obtain specified maximum values of indoor operative temperature (28, 29 and 30 °C) as a function of the parameters described in Section 2. The blank cells indicate that a passive solution is not sufficient, and that for these cases additional cooling equipment would be needed.

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#### For basic cases, the following table can be used.

Tref 28			28	°C		29 °C				30 °C			
Zone	CASE	A	В	C	D	Α	B	С	D	A	В	C	D
_	TL			SPD	<b>₩PNR</b>			SPD	PNP				<b>PNP</b>
F1	L		SPD	SPD	<b>PNP</b>			SPD	<b>PNP</b>			SPD	<b>PNP</b>
	ML		SPD	SPD	<b>PNP</b>			SPD	PNP			SPD	<b>PNP</b>
	Le	SPD	SPD	PNP			SPD	SPD	PNP		SPD	SPD	<b>BNP</b>
	TLe	<b>PNP</b>	<b>PNP</b>	PP		SPD	<b>PRNP</b>	PNR		SPD	SPD	PNP	PNP
	TL							SPD	PNP			SPD	PNP
F2	L				1		SPD	SPD	<b>PNP</b>			SPD	<b>RNP</b> ₀
	ML						SPD	PNP	PNP			SPD	<b>PNP</b>
)	Le					SPD	SPD	₿PNP.			SPD	PNR	<b>PNP</b>
	TLe					∦PNP.	PNP			SPD	PNP	PNP	
	TL	[				SPD	SPD	PNP			SPD	SPD	<b>PNP</b>
F3	L					SPD	SPD	PNP			SPD	PNP	
	ML					SPD	<b>PNP</b>	PNP		SPD	SPD	PNR	
	Le					PNP	PNP.			SPD	PNP	PNP	
	TLe									PNP			
[	TL					PNP	စုနှစ်			SPD	<b>PRNP</b>	1500	
F4	L	][				PNP				SPD	PNP	[ PIP	
	ML	lí				PNP				PNP	PNP	<u>I</u>	
	Le	]]								<b>PNP</b>	( )))) ( ) ( )) ( )		
	TLe	l											

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#### More detailed results are given below.

Inertia		Zon	e F1			Zon	e F2		Zone F3				Zone F4			
					N	Maxim	um op	erative	temp	eratur	e: 27 °	С	л., <u>, , , , , , , , , , , , , , , , , , ,</u>			
CASE	A	B	C	D	A	B	С	D	A	B	С	D	A	В	C	D
TL		SPD	SPD	PNP	SPD	SPD	PNP		PNP	PNP.	-			_		
L		SPD	PNP	PNP.	SPD	SPD	PNP		PNP	÷	1					
ML		SPD	PNP	R. J. Marine	SPD	<b>PNP</b>	PP	1	PNP		r ~~		ſ	e	i.	
Le	SPD	PNP	PNP		PNP	PP.			1.100.12.1.100.0			č				
TLe	PNP	(PP)		2 1	1 - ME - 3		· · · · ·		····					' <u></u> ;		
<u></u>					N	<i>M</i> aximi	um op	erative	temp	eratur	∋: 28 °	С	! <u></u>	·····		
CASE	Α	В	С	D	A	В	C	D	A	В	С	D	A	В	С	D
TL			SPD	PNP		SPD	PNP	PNP	SPD	PNP	(PP)		ାଇଇ			
L		SPD	SPD	PNP		SPD	PNP		SPD	PNP	[]]P				-	
ML		SPD	SPD	PNP	SPD	SPD	PNP		SPD	PNP						
Le	SPD	SPD	PNP		SPD	PNP	PP		PNP		. i	1		( <b></b>	, ,	
TLe	PNP	PNP	<b>PP</b>	5 · · · ·	PNP		Ň		1 20 2. 400			· · · · · · · · · · · · · · · · · · ·			··	
			_		N	/laximi	um op	erative	temp	erature	e: 29 °	C			<u> </u>	<u>.                                    </u>
CASE	A	В	С	D	A	В	C	D	A	В	С	D	A	В	С	D
TL			SPD	PNP			SPD	PNP	SPD	SPD	PNP		PNP	N 29		
L			SPD	PNP		SPD	SPD	PNP	SPD	SPD	PNP		PNP		;	Y I
ML			SPD	PNP		SPD	PNP	PNP	SPD	PNP	PNP		PNP			
Le		SPD	SPD	PNP	SPD	SPD	PNP		PNP	PNP					· · · · · · · · · · · · · · · · · · ·	
TLe	SPD	PNP	PNP		PNP	PNP		>						i i	:	
		_			N	/laximi	um op	erative	temp	erature	e: 30 °	C				
CASE	A	В	С	D	A	В	С	D	A	В	С	D	Α	В	С	D
TL				PNR			SPD	PNP		SPD	SPD	PNP.	SPD	PNP	PP	
Ļ			SPD	RNP			SPD	PNP		SPD	PNP		SPD.	PNP	1PP)	
ML			SPD	PNP			SPD	PNP	SPD	SPD	PNP		<b>PNP</b>	PNP		
Le		SPD	SPD	PNP		SPD	<b>PNP</b>	PNP	SPD	PNP	PNP		<b>PNP</b>			·
TLe	SPD	SPD	PNP	PNP	SPD	PNP	PNP		PNP							
					N	/laxim	um opi	erative	tempe	erature	e: 31 °(	0	<u>.</u>			
CASE	Α	В	С	D	A	В	С	D	Α	В	С	D	Α	В	C	D
TL				SPD			SPD	PNP		SPD	SPD	PNP	SPD	SPD	PNP	
				SPD			SPD	PNP		SPD	SPD	PNP	SPD	SPD	PNP	
ML				RNP			SPD	PNP		SPD	SPD	PNP	SPD	PNP.	PNP	
Le			SPD	PNP		(SPD)	SPD	PNP	SPD	SPD	PNP		SPD.	PNP	(RP)	
TLe	SPD	SPD	SPD	PNP	SPD	PNP	PNP		PNP	PNP	(PP)		PNP			
					N	laximu	um ope	erative	tempe	erature	e: 32 °(	0				
CASE	Α	В	С	D	Α	В	С	D	Α	В	С	D	Α	В	С	D
TL				SPD				SPD			SPD	PNR		SPD	PNP	PNP
L				SPD				PNP			SPD	PNP		SPD	PNP	
ML				SPD			SPD	PNP		SPD	SPD	PNP	SPD	SPD	BNR	
Le				PNR			SPD:	PNP		SPD	PNP	PNP	SPD	PNP	PNP	
TLe		SPD	SPD	PNP	SPD	SPD	PNP	<b>PNP</b>	SPD	PNP	PNP		PNP	PNP		

# Chapter F

# Ground coupled air systems

Developed b	y: Sav	time and	uttar, antig	Samite - 424
Name:	Mark 7	Zimmer	mann	and
	Stefan	Remur	d	
Organisation:	Eidg M	aterialpr	ufungs	und
	Forse	hungsar	nstalt	
Address:	CH=80	500		- -
Phone:	A118	001/SWI	tzerian	0
Eax	4118	21 62 44	1	
E-mail:	mark z	mmerm	ann@e	mpa.ct
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#### 1 Introduction

Ground coupled air systems have become quite popular in Central Europe. They are primarily used for preconditioning outdoor air in summer. The outdoor air is supplied to the ventilation system via an underground ducting system where the ground functions as thermal mass, helping to compensate seasonal and daily temperature variations. As well as the cooling effect in summer, there is also an air preheating effect in winter. (See Figures 1 and 2.) However the benefit is greatest in summer since air preheating in winter only acts to reduce the heat recuperation in the exhaust air heat exchanger. One advantage, however, is to help to prevent icing of the heat exchanger, leading to a simpler mode of operation.



Figure 1 Typical operating schemes of an air ground coupling system in summer (left) and in winter (right)



**Figure 2** Large ground coupling system<sup>(1)</sup> during construction. The pipes are brought into position before the basement slab is cast



Cooling performance at T = 25 ± 0.5 °C [K]

Figure 3 Ground coupling system performance for different climates

The use of ground coupling is suited to climates having a large temperature differential between summer and winter, and also between day and night. Figure 3 shows the performance in different climates. The most appropriate applications are in the moderate climate of Central Europe. The cooling power is reduced in very hot climates whereas in cooler climates, as well as the cooling power being greater, there is normally only a small cooling demand which has to be met.

In principle, ground coupled air systems can be used both for independent cooling of room air and to supplement other cooling systems. As ground coupling merely precools the air, further cooling of the supply air can (if necessary) be done by additional cooling, or alternatively heat can be extracted from a room using static cooling surfaces (eg cooling ceilings, slab cooling). The following combinations may be considered:

- Ground coupled air systems with natural night-time air cooling
- Ground coupled air systems with mechanical night-time air cooling
- Ground coupled air systems with slab cooling/cooled ceiling

Combinations with adiabatic systems (evaporation cooling) are less appropriate. Combinations with geothermal wells or using ground-water are possible, but it is usually more economic to use the latter as stand-alone systems, ie without ground coupled air systems.

In designing the ground coupled air systems, a distinction should be made between the following systems (see Figure 4).

#### **Comfort cooling**

Ground coupling is used solely to improve comfort without predefined cooling capacity. Typical applications are displacement ventilation systems for office buildings with low internal loads and for conditioning outdoor air in domestic buildings, atria, etc, with mechanical ventilation. In both these cases the air flow rates are relatively small (air chauge rate 0.5-1.0 h<sup>-1</sup>), and it is important that the supply temperature lies below room temperature. Ground coupled air systems fulfil this important criterion for displacement ventilation systems as the exit temperature from ground coupled air systems is always below that of the room air, provided the room is not otherwise cooled. However, it must be permissible for the room air temperature to rise on hotter days. With increasing outdoor air temperature, the output of ground coupling systems increases strongly as a function of temperature difference between ground and outdoor air. Ground coupling is thus particularly well suited to the efficient removal of external heat loads.

#### Room cooling

The function of ground coupled air systems is to remove internal heat loads via the ventilation system. In cases where internal heat loads have to be removed, larger air flow rates are required. The cooling capacity depends primarily on outdoor temperature and on the condition of the ground. Under constant load, the cooling capacity of the ground may become exhausted. As a stand-alone measure, it is not generally possible for the ground to meet a constant level of high loads. From experience, the maximum values lie around  $30-50 \text{ Wh/m}^2d$  (with respect to the total floor area) at an air change rate of  $2.0 \text{ h}^{-1}$ . As soon as the outdoor temperature falls below 19 °C (eg at night-time), provision should be made for outdoor air to be extracted directly via a by-pass, and the air change rate increased to around  $4.0 \text{ h}^{-1}$ . This mode of operation permits regeneration of the ground coupling system.

#### Auxiliary cooling

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Ground coupled air systems are used to supplement an existing cooling system. Greater heat loads can be removed by combining ground coupled air systems with other cooling systems. For example, existing refrigeration plant can be used to cover peak loads. However, it should be remembered that as a rule both low supply air temperatures (for reasons of comfort) and large air flow rates (leading to high fan consumption) should be avoided. For still higher loads, it is an advantage to separate ventilation and cooling systems. Here, the ground coupled air system supplies cooled outdoor air to the room, while the static cooling surfaces remove the remaining heat. At a heat load of around 100 Wh/m<sup>2</sup>d, this can be achieved very efficiently by means of concrete slab cooling. For extreme heat loads, mechanically cooled ceilings are appropriate.

Operation mode	Temperatures	Performances
Comfort cooling	35 30 25 20 15 Outlet air temperature Outlet air temperature	Cooling at 25 °C 8.3 K Cooling perform. 1138 kWh/a Service hours 8760 h
	10 26.07 27.07 28.07 29.07 30.07	
Room Cooling temperature controlled, on at Text > 19 °C	35 30 25 20 15 10 26.07 27.07 28.07 29.07 30.07	Cooling at 25 °C 8.6 K Cooling perform. 558 kWh/a Service hours 926 h
Auxiliary Cooling controlled by main cooling system, here: 06.00-18.00 hours	35 30 25 20 15 10 26.07 27.07 28.07 29.07 30.07	Cooling at 25 °C 9.3 K Cooling perform. 873 kWh/a Service hours 4380 h

**Figure 4** Overview of typical operation modes for ground coupled air systems. Long operation hours give a high yearly performance whereas short operation hours result in better peak performance (Zürich, 1 pipe, 250 m<sup>3</sup>/h, diameter 0.2 m, length 30 m, depth 2.5 m)

### 2 Parameters

# 2.1 Positioning

The ground coupling system should be positioned as deep as possible in the ground. Figure 5 shows the ground temperatures as a function of depth and time of year. However, the excavation costs for laying the ground coupling system represent a significant fraction of total installation costs, and costs for deeper excavation are usually prohibitive.

The distance between the pipes should be about 1.0 m. At smaller spacings, mutual interference between the pipes is too great. For the daily charging and discharging cycle to function correctly, much greater spacings are not advisable. When positioned beneath a building, it is essential that the basement rooms are unheated. Even on the assumption that the basement is well insulated ( $U = 0.5 \text{ W/m}^2\text{K}$ ), about 40 kWh/m<sup>2</sup>a of heat is lost, causing the ground to heat up.

Although wet and heavy soils are an advantage in terms of thermal performance, the presence of ground-water involves extensive sealing precautions carrying a cost penalty (see Table 1).



**Figure 5** Ground temperatures at different depths for Zurich. A depth of 2 to 4 m is recommended for ground coupled air systems. Owing to the time shift, temperatures are still relatively low at this depth during the month of July

Table 1         Properties of different soil qualities <sup>[2]</sup> . The influence on the cooling           parformance is loss than +10 % and therefore relatively small											
Properties											
Ground type	W/mK	kg/m <sup>3</sup>	J/kgK	Cooling (%)							
Wet soil	1.5	1400	1400	100							
Dry sand	0.7	1500	920	90							
Wet sand	1.88	1500	1200	98							
Damp clay	1.45	1800	1340	104							
Wet clay	2.9	1800	1590	105							

# 2.2 Size

The size of ground coupling systems depends on the design air flow rate and on the area available. Smaller systems, for example for improving comfort in domestic buildings, can be built at relatively low cost. In particular, the inlet and outlet ducts can be simply designed. Larger plants, as well as those immersed in ground-water, are considerably more costly since large inlet and outlet ducts are required as terminal point, for the pipes.

To limit the pressure drops in the piping system, the air velocity in the pipe should be about 2.0 m/s. In the case of plastic pipes in common use with a diameter of 20 cm, this is equivalent to a flow rate of 250 m<sup>3</sup>/h per pipe. The exact values can be taken from Figure 6.

The optimum pipe length is a function of pipe diameter and air velocity. Pipes over 40 m in length perform efficiently only when of larger diameter (see Figure 7). With long pipes, thermal expansion must be very carefully considered.



**Figure 6** Volume flow rate per ground coupling pipe. When selecting the type of pipe it is advisable to choose small diameters between 15 and 25 cm with air velocities around 2 m/s



**Figure 7** Influence of pipe length on cooling performance. 80% of the maximum performance should be considered as optimum. If long distribution ducts are situated before the piping system, their influence on the performance can also be taken into account

# 2.3 Operation

The mode of operation depends primarily on the particular application. Wherever possible, complex control procedures should be avoided. The following modes of operation are recommended for the three typical systems mentioned earlier.

#### **Comfort cooling**

To achieve best results, the air should always be passed through the ground coupling system. Air flow rate and duration of operation depend on the ventilation system. Ground regeneration should take place when outdoor temperatures are low.

#### Room cooling

In cases where internal loads must be removed and where the ground coupling system must ensure that a maximum room temperature is not exceeded, the system should be in operation only when absolutely necessary. For outdoor temperatures below 19 °C, the simplest procedure is to supply outdoor air directly by means of a by-pass. If a building control system is installed, the temperature difference between the room and outdoor air (eg  $\Delta T > 5$  K) can be used as a criterion for direct supply. Since the supply of outdoor air is practically unlimited, the air flow rate can be increased in this mode of operation to correspond to an air change rate of 4 h<sup>-1</sup>. For this system most of the heat should be removed by outdoor air cooling, so that the ground coupling system is only required for peak loads during daytime.

#### Auxiliary cooling

With auxiliary cooling, continuous operation of the ground coupled air systems is also to be recommended. Regulation of total cooling capacity is best delegated to the conventional system. The ground coupled air system has a compensating effect, reducing temperature extremes, and is selfregenerating during cold periods.

# 3 Design charts and tables

When the location, position and mode of operation have been determined, an estimate of the ground coupling system output can be made. The peak performance as well as the yearly output performance have to be considered. Figure 7 and Table 2 give an overview of the relationship between these two performances. Usually, the calculation of the peak performance will be more important. Figures 8 and 9 and Table 3 can be used to size simple systems.

In more complex cases, or to obtain more precise values, simulations should be carried out using a suitable computer program (see box).

Table 2 Cooling performance (K) of ground coupled air systems for different weather conditions and different locations (pipe length 30 m, pipe diameter 0.2 m, depth in ground 2.5 m, volume flow rate 250 m<sup>3</sup>/h). The table shows how much the air can be cooled at different temperature levels ( $\pm$ 0.5 is degrees K) and the service hours at these temperatures (SD = standard deviation)

	Annual	Inlet temp (°C):									<u></u>		
	mean	15±0	.5	20±0	.5	25±0	.5	30±0	.5	Servi	ce hour	s	
Location	temp (°C)	Avg	SD	Avg	SD	Avg	SD	Avg	SD	15	20	25	30
Almeria (Spain)	18.0	0.8	0.2	1.8	0.9	3.2	1.2	6.2	0.9	27	266	361	132
Messina (Italy)	17.9	0.7	0.1	2.0	1.0	3.0	1.2	6.0	0.6	36	180	307	149
Sacramento (USA)	15.0	1.7	0.7	2.2	1.3	5.4	1.4	8.4	0.8	69	111	64	54
Rome (Italy)	14.5	2.2	0.9	2.4	1.6	5.1	1.2	8.2	0.9	142	308	153	75
Marseilles (France)	14.3	1.9	0.9	2.4	1.5	5.0	1.0	7.8	0.7	170	392	201	59
Madrid (Spain)	13.9	2.2	0.8	2.3	1.7	5.3	1.4	8.3	0.8	173	393	164	60
Milano (Italy)	12.3	2.8	1.2	3.0	1.8	6.0	1.4	9.2	1.1	201	324	164	62
Locarno (Switzerland)	11.1	2.7	1.6	3.9	1.5	6.8	0.9	9.9	0.6	223	299	143	11
Paris (France)	10.9	2.2	1.3	4.2	1.0	7.4	0.8	10.3		359	244	65	1
Macon (France)	10.6	2.2	1.4	4.4	1.4	7.7	1.1	10.8	0.7	280	205	95	18
London (Britain)	10.5	2.0	1.2	5.0	1.0	8.3	0.7	_		493	198	47	0
Vienna (Austria)	10.2	2.7	1.6	4.3	1.4	7.2	1.0	10.8	0.7	256	311	103	10
Geneva (Switzerland)	10.0	2.5	1.7	4.7	1.4	7.5	0.9	10.7	0.8	266	226	99	25
Dublin (Ireland)	9.7	2.6	1.1	5.6	0.7	8.9	0.8	12.2	0.0	376	123	17	2
Bonn (Germany)	9.7	1.9	1.2	5.2	1.2	7.9	0.8	11.3		376	240	58	1
De Bilt (Netherlands)	9.4	2.4	1.3	5.2	1.1	8.5	0.9	10.5	0.5	369	137	45	2
Zurich (Switzerland)	9.0	2.4	1.5	5.3	1.4	8.3	0.9	11.2	0.5	383	194	62	7
Berne (Switzerland)	8.7	2.6	1.6	5.7	1.5	8.4	0.8	11.5	0.6	359	186	66	10
Hamburg (Germany)	8.5	2.5	1.1	5.8	1.1	8.9	0.7	12.6		398	161	47	1
Innsbruck (Austria)	8.2	2.8	1.7	5.9	1.4	8.8	1.1	11.7	0.4	386	187	42	8
Prague (Czech)	8.0	2.7	1.5	5.9	1.3	9.1	1.1	11.8	0.5	352	162	67	3
Warsaw (Poland)	7.9	2.7	1.5	5.6	1.6	8.7	1.0	11.2	0.6	348	174	68	20
Copenhagen (Denmark)	7.7	3.0	1.1	6.1	0.7	9.6	0.6			449	142	24	0
Stockholm (Sweden)	6.7	3.2	1.4	6.4	1.0	9.4	0.6	—		327	153	37	0
Samedan (Switzerland)	1.4	7.0	1.4	9.7	0.7	12.5	—			163	61	1	0



**Figure 8** Cooling performance and peak performance of ground coupled air systems for different locations (for system definition see Table 2)

#### The Resistance-Capacity Model (detailed in IEA Annex 28 Subtask 2 Report 3)

The calculation of ground coupled air systems is complex because the real geometrical situation and the dynamic behaviour of the system are difficult to simulate. Good results can be obtained with the Resistance–Capacity Model WKM<sup>[3]</sup>, originally developed by Arthur Huber. The WKM considers only a single pipe, surrounded by 50 cm of soil. For daily charging and

- discharging, only this 50 cm layer is calculated with three possible boundary conditions:
- Undisturbed ground, whose temperature is calculated according to the depth in the ground and the outdoor climate
- Ground underneath a building: the boundary temperature is calculated using the basement temperature of the building and the thermal resistance between building and pipe
- Ground between ground coupling pipes: this part is considered to be adiabatic. There is no heat flux through the boundary layer, but the capacity of the soil is considered

The WKM program is analogous to an electrical circuit with resistance and capacity. The portions of the ground with different boundary conditions (undisturbed, building influenced, adiabatic) have to be estimated according to the real conditions. The program calculates four temperature nodes for each boundary condition. The length of pipe is divided into six pipe segments, where the outlet temperature of one segment is the inlet temperature of the next segment.



**Figure 9** Cooling power as a function of pipe diameter, pipe length and volume flow rate for Zürich, continuous operation and depth in ground of 2.5 m (inner diameter of pipe/length of pipe). For locations other than Zürich the corrections in Table 3 should be used

Table 3 Co	Table 3 Correction factors for cooling power at 25 °C for different climates (annual mean temperatures),											
depths of p	iping systems under	ground, and types of	fground									
Annual		Depth										
mean	Correction	under	Correction	Ground	Correction							
temp (°C)	factor	ground (m)	factor	type	factor							
5	1.29	7.0	1.175	Wet clay	105							
6	1.22	6.0	1.17	Damp clay	104							
7	1.15	5.0	1.16	Wet soil	100							
8	1.08	4.0	1.12	Wet sand	98							
9	1.01	3.5	1.09	Dry sand	90							
10	0.94	3.0	1.05									
11	0.87	2.5	1.00									
12	0.80	2.0	0.94									
13	0.73	1.5	0.87									
14	0.66	1.0	0.79									







**Figure 11** Relationship between cooling power, cooling energy and outdoor temperature (Zürich, 250 m<sup>3</sup>/h, pipe diameter 0.2 m, pipe length 30 m, depth 2.5 m, wet soil). The summation curve indicates the amount of cooling energy that can be expected above a selected set point

#### Example

- Four-storey office building, 25 × 16 m, total floor area 1600 m<sup>2</sup>.
- Air flow rate corresponding to an air change rate of 2.0/h (room cooling): volume 10 240 m<sup>3</sup>.
- Number of pipes: 20, diameter 30 cm, 16 m long (note: 15 pipes with diameter of 35 cm are less effective).
- Distribution ducts: with regard to their cooling effect the concrete distribution ducts together
   (1.8 m × 0.8 m) correspond in total to 100 m of pipes (with respect to area of ground contact). This effect is taken into account by a fictitious increase in pipe length of 10 m, giving a total length of 26 m.
- Cooling of inlet air (at outdoor temperatures 25 °C) by 5.8 K to 19.2 °C (Figure 8).

If the building is situated in London with a yearly mean temperature of 10.5 °C the cooling power can be corrected according to Table 3. This results in a corrected cooling of  $0.9 \times 5.8 \text{ K} = 5.22 \text{ K}$ . If the depth of the pipes is 4 m below ground, a second adjustment can be made with a factor of 1.12 (see also Table 2). The ground correction has only to be applied for extremely dry or wet ground. The final cooling will be 5.85 K, resulting in a cooling power of  $512 \text{ m}^3/\text{h} \times 5.85 \text{ K} \times 0.32 \text{ Wh/m}^3\text{K} \approx 960 \text{ W}$ , total  $\approx 19 \text{ kW}$ .

#### Conclusion

The ground coupling system can remove about  $12 \text{ W/m}^2$ . If the internal load is 40 kW ( $25 \text{ W/m}^2$ ) the excess heat may be stored in the building mass and removed by night ventilation.

A combination of the ground coupled air system and night-time ventilation could provide the required standard of comfort. Neither the ground coupled air system nor night-time ventilation alone would be sufficient to fulfil the room temperature criterion of 26 °C.

# 4 Practical guidance

#### 4.1 Air intake

The procedure for air intake has a decisive influence on the quality of the supply air. In addition to fouling of the intake by birds and other small animals, by children, and contamination by suspended particles, etc, the quality of the air at the point of intake is of great importance.

Raising the intake above the ground prevents ingestion of radon gas, which may seep through the ground at any point, reduces the concentration of exhaust fumes from road vehicles, and, as a rule, reduces the air intake temperature. To further ensure low intake temperatures, air intake above parts of the building exposed to strong sunshine or over macadamised surfaces should be avoided. Placement of (odourless) vegetation around the intake can also considerably reduce intake temperatures.

Fouling can be avoided both by restricting access and by mounting a tightfitting grille. Filters can only be recommended if regular inspection and maintenance are assured. Coarse and fine particle filters effectively remove non-volatile air pollutants such as pollen, fungal spores and bacteria. This option should be considered in situations where professional maintenance facilities are available. (See Figures 12 and 13.)



**Figure 12** Air inlet for a medium-sized ground coupling system. Filters for the removal of small particles are placed between the ground coupling system and ventilation plant



**Figure 13** Air inlet for a small ground coupling system with only two pipes. If the inlet is via a vertical well as illustrated, it has to be ensured that no radon gas will enter the system

### 4.2 Distribution and collection ducts

In larger plant, air delivery to the ground coupling system pipes is via a distribution duct. This should be generously sized to ensure that the pressure losses for all air paths are of similar magnitude. The same applies to the collection duct. This ensures that all pipes have the same flow rate.

Distribution and collector ducts should be man-sized, or at a minimum


**Figure 14** Section through concrete distribution duct of a large ground coupling system. The pipes have to allow for thermal expansion



**Figure 15** Concrete collection duct of a large ground coupling system. All pipes are accessible for maintenance

provide crawling access, to enable the ground coupling system to be inspected, and, if necessary, to be cleaned. Both ducts should, as far as possible, be airtight and fitted with drainage and siphon. (See Figures 14 and 15.)

As the distribution duct is at a lower level than the collector duct, drainage here is particularly important to enable condensate, any ground-water or water remaining from cleaning to escape.

If possible, heavy concrete distribution ducts should be chosen. These have the advantage of cooling down outdoor air in summer and preheating it in winter. Ground coupling systems positioned beneath the building are protected against icing. The distribution duct should, if possible, be situated away from the building and be in contact with the ground on all sides.

## 4.3 Ground coupling piping system

Ground coupling pipes are constructed exclusively of round plastic, cement or cement fibre pipes. The choice of material is primarily a question of cost. Figure 16 shows the material costs as a function of diameter. For smaller pipes with diameters of up to about 30 cm, plastic piping based on PVC or HDPE is preferable. For larger diameters, cement pipes are cheaper. However, when



**Figure 16** Prices for different pipe materials (1 US\$ = 1.5 SFr). Small diameters are generally more economic and also thermally more efficient

special seals are called for, this is a very expensive option. In general, larger numbers of small pipes have a better cost-benefit ratio than fewer large pipes.

The position of ground coupling pipes makes them very difficult to repair, so that emphasis should be placed on a long life-cycle (>50 years). For this reason, thin-walled ribbed pipes or hoses are not suitable. The latter are also quite critical as regards fouling, and are also very difficult to clean.

To ensure that condensate, any ground-water or remaining cleaning water can drain off, ground coupling pipes should be inclined at approximately 1% towards the intake (ie against the direction of air flow). In general, it is sufficient to bed the pipes on sand in clean trenches, while shorter cement pipes can be bedded on a small amount of lean concrete.

Straight pipes are the best choice as they are easy to inspect, but curved pipes can also be used. It should be remembered that, owing to temperature changes, pipes are subject to considerable thermal expansion (0.2 mm/mK for HDPE pipes, 0.08 mm/mK for PVC pipes). The distribution and collection ducts must be designed to accommodate thermal expansion. For this, rubber seals are normally provided, which not only permit axial movement but also protect against ground-water. To prevent long-term lateral movement, the pipes are cemented-in at the centre.

## 5 Maintenance

Ground coupled air systems are generally maintenance-free. Inspections carried out on a range of older plant showed no marked degree of fouling<sup>[4]</sup>. The concentration of airborne spores and bacteria was also measured. In the majority of cases air quality with respect to these contaminants was better after passing through the ground coupling system than in the original air (see Figures 17 and 18).

As a precautionary measure it is nevertheless recommended that regular inspections of the ground coupling system and of the remaining system components be made. Attention should be paid in particular to the intake, ducts and other equipment. Particularly in plants with ground-water seepage, regular optical inspections are essential. As with hollow electrical piping, curved ground coupling pipes should be fitted with a non-corrosive wire with which to draw cleaning material tbrougb when necessary. The inclination ensures that cleaning water can drain off.

Particularly with larger plant, it is essential to ensure that intake ducts are not used for storage (especially wood fuel), as this can lead to air contamination.

Filters of the type used in ventilation systems are quite adequate. Pressure loss and fouling should be monitored and the filters cleaned or changed as necessary. In applications where for hygienic reasons higher standards of air quality must be met, further reduction of bacterial and spore concentrations can be achieved by means of fine particle filters.



**Figure 17** Concentrations during summer of fungal spores in the outdoor air, the air leaving the ground coupling system, and the air entering the rooms<sup>[4]</sup>. The numbers of spores are much higher than during winter, but the relationship between the concentrations is similar. No values were available for the fungal concentration entering the food store in Schönenwerd



Figure 18 Concentrations of bacteria during summer<sup>[4]</sup>

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