

## Table of Contents

<b>About the Editors.....</b>	<b>XI</b>
<b>List of Contributors.....</b>	<b>XIII</b>
<b>The IEA Solar Heating and Cooling Programme.....</b>	<b>XV</b>
<b>Notes from the Editors.....</b>	<b>XVII</b>
<b>Foreword.....</b>	<b>XIX</b>
<b>1 Introduction .....</b>	<b>1</b>
1.1 About the IEA SHC Task 48 .....	2
1.2 Ambition and philosophy of the book.....	3
References.....	4
<b>2 General considerations .....</b>	<b>5</b>
2.1 Solar thermal air-conditioning general flowsheet .....	5
2.2 Key design principles.....	7
2.3 General economic considerations.....	13
2.4 Performance assessment of SHC systems.....	16
References.....	18
<b>3 Case study of a solar cooling system with a small NH<sub>3</sub>/H<sub>2</sub>O absorption chiller.....</b>	<b>19</b>
3.1 Application description and design philosophy.....	19
3.1.1 Background.....	19
3.1.2 Rationale for the selected configuration.....	19
3.2 Solar heating and cooling process description.....	21
3.2.1 Flowsheet description.....	21
3.2.2 Control philosophy.....	22
3.2.2.1 Heating and cooling mode selection.....	23
3.2.2.2 Solar and water-heating flow loops.....	24
3.2.2.3 Backup heating flow loop.....	26
3.2.2.4 Chiller process flow loop.....	28
3.3 Equipment specification.....	29
3.3.1 Absorption chiller.....	30
3.3.2 Solar collector field.....	31
3.3.3 Solar heat exchanger.....	34
3.3.4 Thermal storage tank.....	34
3.3.5 Cooling tower.....	36
3.3.6 Pumps and hydraulics.....	36
3.4 Hazard and operability.....	37
3.4.1 Hazard management.....	37
3.4.2 Commissioning/initial startup.....	38
3.4.3 Overall performance monitoring.....	40
3.5 Case study system performance .....	41
3.5.1 Monthly energy flows.....	41
3.5.1.1 Source of heat .....	41

3.5.1.2	Cooling performance.....	41
3.5.1.3	Heating performance.....	45
3.5.1.4	Combined heating and cooling performance.....	46
3.5.2	Instantaneous and daily energy flows.....	47
3.6	Modeling performance analysis.....	51
3.6.1	TRNSYS component simulation methodology.....	51
3.6.2	Case study simulation scenarios.....	52
3.6.3	Results.....	52
3.6.3.1	Cold production ( $Q_{SS,HP}$ ).....	57
3.6.3.2	Seasonal performance factor ( $SPF_{el,thC}$ ).....	57
3.7	Indicative commercial analysis.....	58
3.8	Quality assurance checklist.....	61
3.8.1	Lessons learned.....	61
3.8.2	Evaluation against principles.....	62
	References.....	64
<b>4</b>	<b>Case study of a solar cooling system combining an absorption chiller with domestic hot water production.....</b>	<b>67</b>
4.1	Application description and design philosophy.....	67
4.1.1	Background.....	67
4.1.2	Rationale for the selected configuration.....	68
4.2	Solar cooling process – description and design philosophy.....	69
4.2.1	Flowsheet description.....	69
4.2.2	Control Philosophy.....	71
4.2.2.1	Cooling/hot water mode selection.....	71
4.2.2.2	Control of solar primary circuit pump (Pump 1).....	72
4.2.2.3	Control of the solar secondary circuit pump (Pump 2).....	72
4.2.2.4	Control of the absorption chiller (pumps 3, 4 and 5, cooler fan).....	72
4.2.2.5	Control of the domestic hot water heating pumps (pumps 6 and 7).....	73
4.3	Equipment specifications.....	73
4.3.1	Absorption chiller.....	73
4.3.2	Solar collector field.....	75
4.3.3	Evaporatively-cooled dry cooler.....	77
4.3.4	Thermal storage tank.....	78
4.3.5	Drain-back tank.....	79
4.3.6	Pumps.....	79
4.4	Hazard, operability and installation experiences.....	80
4.4.1	Hazard management.....	80
4.4.2	Installation experiences.....	80
4.4.2.1	Architectural issues.....	82
4.4.2.2	Installer skills.....	82
4.4.2.3	Use of the stairwell.....	82
4.4.2.4	Installation in an occupied building.....	82
4.4.2.5	Evaporator circuit connection to the main chilled water circuit.....	82
4.4.3	Commissioning/initial startup.....	83
4.4.4	Overall performance monitoring.....	83

4.5	Case study system performance .....	83
4.5.1	Monthly energy flows.....	83
4.5.1.1	Source of heat .....	85
4.5.1.2	Cooling and heating performance .....	85
4.5.2	Daily energy flows.....	86
4.6	Modeling performance analysis.....	87
4.6.1	TRNSYS component simulation methodology .....	87
4.6.2	Results.....	87
4.6.2.1	Solar collector tilt angle scenario analysis.....	90
4.7	Indicative commercial analysis.....	91
4.7.1	Actual project.....	91
4.7.1.1	Capital investment cost .....	91
4.7.1.2	Annual operating and maintenance costs.....	92
4.7.2	Greenfield sites (IEA Task 48 methodology) .....	94
4.8	Quality assurance checklist .....	94
4.8.1	Lessons learned.....	94
4.8.2	Evaluation against principles .....	95
	References.....	97
<b>5</b>	<b>Design guide for solar cooling with double-effect absorption chillers ..</b>	<b>99</b>
5.1	Application description and design philosophy.....	99
5.1.1	Background .....	99
5.1.2	Rationale for the selected configuration.....	100
5.1.2.1	Solar collector field selection/sizing.....	101
5.1.2.2	Backup heat source .....	102
5.1.2.3	Hydraulics.....	102
5.2	Solar cooling process description.....	104
5.2.1	Flowsheet description.....	104
5.2.2	Control philosophy.....	105
5.2.2.1	Solar flow loop .....	105
5.2.2.2	Chiller process flow loop .....	106
5.2.2.3	Cooling water flow loop .....	108
5.3	Equipment specification .....	108
5.3.1	Absorption chiller.....	110
5.3.2	Solar collector field.....	110
5.3.3	Thermal storage tank .....	112
5.3.4	Pumps .....	113
5.4	Hazard and operability.....	114
5.4.1	Hazard management.....	114
5.4.2	Commissioning/initial startup.....	115
5.5	Case study system performance .....	117
5.6	Design performance analysis .....	120
5.6.1	TRNSYS component simulation methodology .....	120
5.6.2	Case study simulation scenarios .....	122
5.6.3	Results.....	122
5.6.3.1	Storage tank sizing, Sydney location .....	122

5.6.3.2	Impact of climate.....	124
5.7	Indicative commercial analysis.....	126
5.8	Quality assurance checklist.....	133
5.8.1	Lessons learned.....	133
5.8.2	Evaluation against principles .....	134
	References.....	137
	<b>Index.....</b>	<b>139</b>