



Task 45

Large Systems

Large solar heating/cooling systems,
seasonal storages, heat pumps

Subtask A: Collectors and collector loop



Detailed Work Plan Subtask A, revision 1

May 18, 2011 (rev October 28, 2011)

Editor: Simon Furbo

Relevance of SUBTASK A in IEA TASK 45

Large Solarthermal Systems (> 0,5MW) have enormous potential for fossils and CO₂ reduction. International large solar thermal plants are getting more importance in heat production for feeding district heat networks, industrial processes and thermal driven chillers.

Numerous projects in Europe (especially in Denmark), China and Arabic area emphasize this trend impressively. Beneath the large potential large solar thermal installations have been proven to be economical and sustainable. Feeding the local district heat network with exceeding energy is reasonable and has been demonstrated extensively in Denmark and also Austria very effective.

The central problem of solar thermal plants is that there is selective know-how available for different system parts, but most important issues like overall system concepts, collector fields, storages, heat pumps for lowering temperature and more storage density, monitoring concepts and efficient operating control, financing models etc. have no proven and harmonized standards. So potential for economics of scale and cost reduction for large scale solar thermal plants could not build advantages so far. Also a structured technology development on international level is not given until now.

Central aim of Task 45 is to connect the most substantial players through analysis, discussion of implemented and future projects and simulation based optimization of components and systems, as well as the development of components and systems standards beneath considerable cost reduction potential at coincidental increased system efficiency to reach the next generation of large solar thermal installations. The planned transfer to central players and stakeholders is essential for sustainable impact the current market development.

Facing the increasing demand and the enormous potential of large solar thermal plants the need for competent and independent answering of these questions is given and will be handled in Task 45.

IEA Task 45 SUBTASK A "Collectors and collector loop" serves the need for research, development and/or optimization on:

- Components for solar collector fields
- Design of solar collectors for different applications
- Thermal performance of solar collectors for different volume flow rates, collector tilts and solar collector fluids
- Control strategy for solar collector fields
- Requirements and test methods for solar collector loop pipes
- Requirements on hydraulic design of solar collector fields
- Precautions for safety and expansion
- Guaranteed performance of solar collector fields
- Description of further needed research on solar collector fields
- Contribution on planning and installation of solar collector fields for design handbook

Detailed Description of the Subtask Management

Project Management Lead of Subtask A	
Start: 04/11 End: 12/13	Subtask Leader: DTU, Denmark
<p>Objectives:</p> <ul style="list-style-type: none"> • Structured accomplishment of all objectives of Subtask A in the defined time and deliverable plan • Lead of the subtask in form and content due to targeted objectives of the work plan and best usability of results 	
<p>Description:</p> <p>Management of Subtask A</p> <p>For success and positive outcome of the subtask following coordination measures have to be done:</p> <ul style="list-style-type: none"> • Internal communication – organization and procedure of at least 3 project meetings, quality management of defined workplan contents, quality management on time table • External communication (constant information to the Task 45 operation agent on project development, results and events) • Reporting – Intermediate report and final report <p>Administrative and coordinative lead of Subtask A</p> <p>For best results achievements in Subtask A following measures are essential:</p> <ul style="list-style-type: none"> • More detailed workplan definition after the kick-off meeting and active working start of the subtask group • Organisation of task meetings during TASK 45 meetings (half a year) in regard of key aspects of the workplan and records in writing of meetings • Monitoring of work progress • Reconciliation of content and coordinative work with the operating agent and the other subtask leaders • Reporting matching with the operating agent 	
<p>Methods:</p> <ul style="list-style-type: none"> • Administrative and contentual project planning • Project support and adaption/correction of project planning if needed • Project meetings 	

Milestone (M) und Deliverables (D):

M1, D1: Detailed work program is ready

M2, D2: Interim report for Subtask A

M3, D3: Final report Subtask A

Objectives Subtask A – Collectors and collector loop

The general overall objectives of this subtask are to assure:

- Use of suitable components for solar collector fields
- Good designs of solar collector fields
- Proper and safe installations of solar collector fields
- Good interplay between solar collector fields and district heating and cooling networks
- High thermal performance of solar collector fields

SUBTASK A Work plan & Deliverables

Subtask A Deliverables	2011			2012			2013		
A-D1: Models for correction of collector efficiency parameters depending on collector type, flow rate, tilt and fluid type					D	R ₁		R	
A-D1-1 Collector type					D	R ₁		R	
A-D1-2 Flow rate					D	R ₁		R	
A-D1-3 Collector tilt					D	R ₁		R	
A-D1-4 Solar collector fluid					D	R ₁		R	
A-D2 If possible: Proposal for an informal annex to be included in EN 12975 / ISO 9806-1 describing how to make the above mentioned corrections									
A-D3 Proposal for requirements and test methods for collector loop pipes (safety, durability, heat loss, thermal expansion) - pre-normative work - to be proposed to the relevant ISO/CEN TC's					D	R ₁		R	
A-D4 Guidelines for requirements for collector loop installation, hydraulic scheme including precautions for safety and expansion including check list for checking installation accordingly					D	R ₁		R	
A-D5 Detailed simulation models for solar collector fields (thermal performance)								D	R ₁ R
A-D6 Control and operation strategies for solar collector fields								D	R ₁ R
A-D7 Procedure for guaranteeing performance of collector field installation - including how to check the guarantee - and including validation on existing fields								D	R ₁ R
A-D8 Procedure for guaranteeing performance of solar loop heat exchanger - including how to check the guarantee - and including validation on existing fields						D	R ₁ R		
A-D9 Input to Task web site								D	
A-D10 Input to "Design Handbook"								D	
A-D11 Subtask A Summary Report								D	
Milestones: D: Draft reports(s); R Final reports(s); R ₁ : First Report; D ₁ : First Draft									

Time- and Milestone plan for Task 45 Subtask A



Detailed Description of the Work plan Deliverables and Activities

Subtask A Deliverable Number / Name	Deliverable Description and Draft Planning	Responsible Partner	Active Participants	Deadline	Duration M/Y	Deliverables for next Meeting 10/2011	Deliverables for next Meeting 05/2012
A-D1: Models for correction of collector efficiency parameters depending on collector type, flow rate, tilt and fluid type	<p>May-October 2011: Stand-by until results from D1-1, D1-2, D1-3 and D1-4 are available</p>	DTU	DTU, IREC, UNIFI, NRC/NSTF	June 2013	04/2011 - 06/2013		
A-D1-1: Collector type	<p>May-June 2011: <u>DTU</u>: Make activity plan inclusive time table on flat plate collectors. Email plan to IREC, UNIFI and NRC/NSTF for comments IREC: Make activity plan inclusive time table on Fresnell collectors. Email plan to DTU, UNIFI and NRC/NSTF for</p>	DTU	DTU, IREC, UNIFI, NRC/NSTF	June 2011	04/2011 - 06/2013	Send around activity plans OK IREC	Mark Thornblom USA Standard 600 SRCC test results

	<p><u>comments</u></p> <p><u>UNIFI</u>: Make activity plan inclusive time table on PTC collectors. Email plan to IREC, DTU and NRC/NSTF for comments</p> <p><u>NRC/NSTF</u>: Make activity plan inclusive time table on flat plate collectors. Email plan to IREC, UNIFI and DTU for comments</p>					Stand by	
	<p>July 2011: <u>DTU, IREC, UNIFI and NRC/NSTF</u>: Comment on activity plans</p>	DTU	DTU, IREC, UNIFI, NRC/NSTF	July 2011			
	<p>June-October 2011: <u>DTU</u>: Measure efficiencies of two identical flat plate collectors with the exception that one collector has a single glass cover and one collector has a Teflon foil and a glass cover.</p> <p><u>IREC</u>: Start investigations</p> <p><u>UNIFI</u>: Start investigations</p> <p><u>NRC/NSTF</u>: Start investigations</p>	DTU	DTU, IREC, UNIFI, NRC/NSTF	October 2011			
	<p>24-25th October 2011: <u>DTU, 3 UNIFI and NRC/NSTF</u>: Present activity plans and preliminary results of investigations</p>	DTU	DTU, IREC, UNIFI, NRC/NSTF	October 2011		Powerpoint presentation DTU	DTU will continue and present more test results
A-D1-2: Flow rate	<p>May-June 2011: <u>DTU</u>: Make activity plan inclusive time table on flat plate collectors. Email plan to IREC, UNIFI and</p>	DTU	DTU, IREC, UNIFI, NRC/NSTF	June 2011	04/2011 - 06/2013		Steve Harrison and Alfred Brunger Theoretical

	<p>NRC/NSTF for comments</p> <p><u>IREC</u>: Make activity plan inclusive time table on Fresnell collectors. Email plan to DTU, UNIFI and NRC/NSTF for comments</p> <p><u>UNIFI</u>: Make activity plan inclusive time table on PTC collectors. Email plan to IREC, DTU and NRC/NSTF for comments</p> <p><u>NRC/NSTF</u>: Make activity plan inclusive time table on flat plate collectors. Email plan to IREC, UNIFI and DTU for comments</p>						<p>Background for flow rate dependence</p> <p>Alfred Brunger possible Solar Simulator test of fluid and flow rate variation. Needs to be specified more and adapted to Canada's workplan.</p>
	<p>July 2011:</p> <p><u>DTU, IREC, UNIFI and NRC/NSTF</u>: Comment on activity plans</p>	DTU	DTU, IREC, UNIFI, NRC/NSTF	July 2011			
	<p>June-October 2011:</p> <p><u>DTU</u>: Start to measure efficiencies of two flat plate collectors for different volume flow rates</p> <p><u>IREC</u>: Start investigations</p> <p><u>UNIFI</u>: Start investigations</p> <p><u>NRC/NSTF</u>: Start investigations</p>	DTU	DTU, IREC, UNIFI, NRC/NSTF	October 2011			
	<p>24-25th October 2011:</p> <p><u>DTU, IREC, UNIFI and NRC/NSTF</u>: Present activity plans</p>	DTU	DTU, IREC, UNIFI,	October		Powerpoint presentatio	

	and preliminary results of investigations		NRC/NSTF	2011		n DTU	
A-D1-3: Collector tilt	May-June 2011: <u>DTU</u> : Make activity plan inclusive time table on flat plate collectors	DTU	DTU	June 2011	04/2011 - 06/2013	Draft	
	24-25th October 2011: DTU: Present activity plans	DTU	DTU	October 2011		Powerpoint presentation	
A-D1-4: Solar collector fluid	May-June 2011: <u>DTU</u> : Make activity plan inclusive time table on flat plate collectors. Email plan to IREC, UNIFI and NRC/NSTF for comments <u>IREC</u> : Make activity plan inclusive time table on Fresnell collectors. Email plan to DTU, UNIFI and NRC/NSTF for comments <u>UNIFI</u> : Make activity plan inclusive time table on PTC collectors. Email plan to IREC, DTU and NRC/NSTF for comments <u>NRC/NSTF</u> : Make activity plan inclusive time table on flat plate collectors. Email plan to IREC, UNIFI and DTU for comments	DTU	DTU, IREC, UNIFI, NRC/NSTF	June 2011	04/2011 - 06/2013		Steve Harrison Alfred Brunger Collector Fluid influence Theoretical Background Alfred Brunger possible Solar Simulator test of fluid and flow rate variation. Needs to be specified more first
	July 2011: <u>DTU, IREC, UNIFI and NRC/NSTF</u> : Comment on activity	DTU	DTU, IREC, UNIFI, NRC/NSTF	July 2011			

	plans						
	June-October 2011: <u>IREC, UNIFI, NRC/NSTF:</u> Start investigations	DTU	DTU, IREC, UNIFI, NRC/NSTF	October 2011			
	24-25th October 2011: <u>DTU, IREC, UNIFI and NRC/NSTF:</u> Present activity plans and preliminary results of investigations	DTU	DTU, IREC, UNIFI, NRC/NSTF	October 2011		Powerpoint presentations	DTU will continue testing and will present new results at next meeting.
A-D2: If possible: Proposal for an informal annex to be included in EN 12975 / ISO 9806-1 describing how to make the above mentioned corrections	May-October 2011: <u>PlanEnergi:</u> Stand-by until results from D1 are available	PlanEnergi	DTU, IREC		04/2013 - 12/2013		JEN at end of task
A-D3: Proposal for requirements and test methods for collector loop pipes (safety, durability, heat loss, thermal expansion) - pre-normative work - to be proposed to the relevant ISO/CEN TC's	May-June 2011: <u>LOGSTOR:</u> Make draft overview of existing relevant standards for requirements and test methods for district heating/cooling pipes June 2011: <u>LOGSTOR:</u> Send to AGFW and SOLID June-July 2011: <u>AGFW, SOLID:</u> give input August- September: <u>LOGSTOR:</u> Make final draft overview September-October: <u>LOGSTOR:</u> Discuss with AGFW	LOGSTOR	LOGSTOR, AGFW, SOLID	June 2011 June 2011 July 2011 September 2011	04/2011 - 06/2013		Thorsten collect AGFW and IEA District heating information Dough Mc Clenahan. Pipe temperature variation information from Drake Landing System Logstor Eg List of

	<p>and SOLID what is missing in this field</p> <p>24-25th October 2011:</p> <p><u>LOGSTOR</u>: Present final draft overview of existing standards etc.</p> <p><u>LOGSTOR</u>: Open discussion what is missing in this field</p>			<p>October 2011</p> <p>October 2011</p>		<p>Powerpoint presentation By Logstor with possible work items</p>	standards for pipes
<p>A-D4: Guidelines for requirements for collector loop installation, hydraulic scheme including precautions for safety and expansion including check list for checking installation accordingly</p>	<p>May-June 2011: <u>AEE</u>: Make draft of existing Austrian guidelines for requirements for collector loop installation, hydraulic scheme including precautions for safety and expansion including check list for checking installation accordingly</p> <p>June 2011: <u>AEE</u>: Send to IREC, AiquaSol, Ritter, SOLID, LOGSTOR, Sweden, AGFW for input from other countries</p> <p>June-July 2011: <u>IREC, AiquaSol, Ritter, SOLID, LOGSTOR, Sweden, AGFW</u>: give input</p> <p>August- September: <u>AAE</u>: Make final draft overview</p> <p>September-October: <u>AEE</u>: Discuss with IREC, AiquaSol, Ritter, SOLID,</p>	AEE-INTEC	AEE-INTEC, IREC, AiquaSol, Ritter, SOLID, LOGSTOR, Sweden, AGFW	<p>June 2011</p> <p>June 2011</p> <p>July 2011</p> <p>September 2011</p> <p>October 2011</p>	<p>04/2011 - 06/2013</p>		<p>AEE Excel Updated work plan</p> <p>Steve Harison Present alternative stagnation prevention method for the collector (patented)</p> <p>AEE-Intec present progress results</p>

	<p>LOGSTOR, Sweden, AGFW what is missing in this field</p> <p>24-25th October 2011:</p> <p><u>AEE</u>: Present final draft overview of existing standards etc.</p> <p><u>AEE</u>: Open discussion what is missing in this field</p>			October 2011		Powerpoint presentation by AEE-Intec.	
A-D5: Detailed simulation models for solar collector fields (thermal performance)	<p>May-June 2011: <u>AiquaSol</u>: Make activity plan inclusive time table</p> <p>July-August 2011: <u>AiquaSol</u>: Discuss plan with IREC</p> <p>September-October 2011: <u>AiquaSol</u> and <u>IREC</u>: Start investigations</p> <p>24-25th October 2011: <u>AiquaSol</u> and <u>IREC</u>: Present activity plan and progress of work</p>	AiquaSol	AiquaSol, IREC	<p>June 2011</p> <p>August 2011</p> <p>October 2011</p> <p>October 2011</p>	04/2011 - 12/2013	Powerpoint presentations	Follow up on time plan <u>Aiguasol</u> not present at meeting
A-D6: Control and operation strategies for solar collector fields	<p>May-October 2011: <u>Planenergi, Marstal, Braedstrup, SOLID, IREC</u>: Describe control and operation strategies for solar collector fields in operation</p>	?	PlanEnergi, Marstal, Brædstrup, SOLID,	October 2011	05/2011 - 12/2013		Revise time plan Present at next meeting <u>Braedstrup</u> not at the Banff

	<p>24-25th October 2011:</p> <p><u>Planenergi, Marstal, Braedstrup, SOLID, IREC:</u> Present control and operation strategies for solar collector fields.</p> <p>Decide A-D6 responsible</p>		IREC	October 2011		<p>Powerpoint presentation by Dough on Drake landing flow optimisation</p>	<p>meeting</p> <p>Drake Landing system TRNSYS modeling information of optimal Delta-T for collector loop</p>
<p>A-D7: Procedure for guaranteeing performance of collector field installation - including how to check the guarantee - and including validation on existing fields</p>	<p>August- September 2011:</p> <p><u>PlanEnergi:</u> Make draft of existing Danish procedure for guaranteeing performance of collector field installation - including how to check the guarantee. Send around for comments.</p> <p>24-25th October 2011:</p> <p><u>PlanEnergi:</u> Present procedure for guaranteeing performance of collector field installation - including how to check the guarantee</p>	PlanEnergi	All	September 2011	04/2011 - 12/2013	<p>Powerpoint presentation by Jan Erik Nielsen</p>	JEN homepage SDH
<p>A-D8: Procedure for guaranteeing performance of solar loop heat exchanger - including how to check the guarantee -</p>	<p>2012:</p> <p><u>PlanEnergi:</u> Make draft of existing Danish procedure for</p>	PlanEnergi	All	2012	01/2012 - 12/2013	<p>Presentation by JEN of homepage</p>	<p>JEN homepage SDH</p> <p>Possible update introduction of</p>

and including validation on existing fields	<p>guaranteeing performance of collector field heat exchanger - including how to check the guarantee.</p> <p>Send around for comments.</p> <p>Present procedure for guaranteeing performance of collector field installation - including how to check the guarantee</p>					SDH	checklist of for example uneven flow distribution in the collector array.
A-D9: Input to Task web site	<p>Frequently:</p> <p><u>DTU</u>: Forward input to operating agent with support from <u>all</u></p>	DTU	All		07/2011 - 12/2013		
A-D10: Input to "Design Handbook"	<p><u>DTU</u>: Prepare input to Design Handbook with support from <u>all</u></p>	DTU	All		07/2012 - 12/2013		
A-D11: Subtask A Summary Report	<p><u>DTU</u>: Prepare summary report with support from <u>all</u></p>	DTU	All		07/2012 - 12/2013		