

SPD0055ERN

PROCESS DESIGN MANUAL

ALARP PROCEDURE
(As Low As Reasonably Practicable)

REV. : 2

DATE : 2013. 7. 20



SAMSUNG
ENGINEERING

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1.0 SCOPE

This procedure defines the requirements and methodology of the ALARP (As Low As Reasonably Practicable) Review, which will be carried out on all process units, utilities, and off-sites on the contracted project. Application starts in the front end engineering phase and continues through all subsequent phases of the project.

This procedure covers the application of ALARP to the **process design** only. References to operating and maintenance procedures should not be made in ALARP assessments unless absolutely necessary. These will be considered during HAZOP.

2.0 PURPOSE

The purpose of the ALARP procedure is to provide a documented demonstration that identified risks have been controlled to a level which is **As Low As Reasonably Practicable**.

3.0 DEFINITIONS

ALARP:	As Low As Reasonably Practicable. Represents the level or risk reduction at which the time, trouble, difficulty and cost of further reduction measures become unreasonably disproportionate to the additional risk reduction to be obtained. ALARP is determined through cost benefit analysis.
BDEP:	Basic Design and Engineering Package
CRITICAL FACILITIES AND OPERATIONS:	Those in which there is a serious risk from incidents related to Health, Safety and Environmental and also have a possible effect on SECL's reputation
HAZARDS:	Defined as a deviation having the potential to cause damage, illness, injury or other form of loss.
HAZOP:	Hazard and Operability Study
HEMP:	Hazards and Effects Management Process is a structured technique for identifying, evaluating and then providing mitigation against hazards and threats to the safe operation of a plant.
PEFS:	Process Engineering Flow Scheme.
PTD:	Permanent Total Disability.
UNIT:	A section of a plant/facility dedicated to performing a distinct process function.

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4.0 RESPONSIBILITIES

4.1 SECL Project Managers

Will be responsible for ensuring that the appropriate BDEP Design Engineers document the risks from hazards identified during the initial HEMP reviews and that these are controlled to the ALARP level during project development. They will also be responsible for ensuring that, where further ALARP studies have been identified, that these are undertaken.

4.2 BDEP Design Engineers

Will be responsible for ensuring that the risks from hazards identified during the initial HEMP reviews are taken into account in design development and are reduced to the ALARP level. Documentation should be produced to describe the steps taken including completion of the forms shown in attachments 7.1 and 7.2.

4.3 SECL HSE Engineers

Will review the documented demonstration of the reduction of risks to the ALARP level during PEFS review and development. Will make periodic assessments to validate conformance to this procedure and consistency of application. Will contribute to ALARP Team reviews as required.

4.4 SECL Project Coordinator

Will review all ALARP Assessment Templates for completeness. Will ensure the ALARP review is carried out for each unit, and that any areas that may benefit from further ALARP study are discussed with the Project Manager. They will also be responsible for obtaining a unique document identification number and for keeping an index of all the ALARP studies completed. They should then issue the completed forms via document control for project filing.

4.5 SECL Engineers

Will be responsible for incorporating the approved actions arising from the ALARP reviews into detail plant design and development. In addition they will be responsible for ensuring that any new risks identified during design development are mitigated by the application of the ALARP principle. Where queries arise they will seek resolution via the SECL Project Manager.

4.6 ALARP Team

Where an ALARP team review is called, the team will consist of ALARP facilitator (SECL), Process Engineer, Instrument Engineer, SECL Project and/or Process representative and other specialists on an as required basis e.g. Mechanical, etc.

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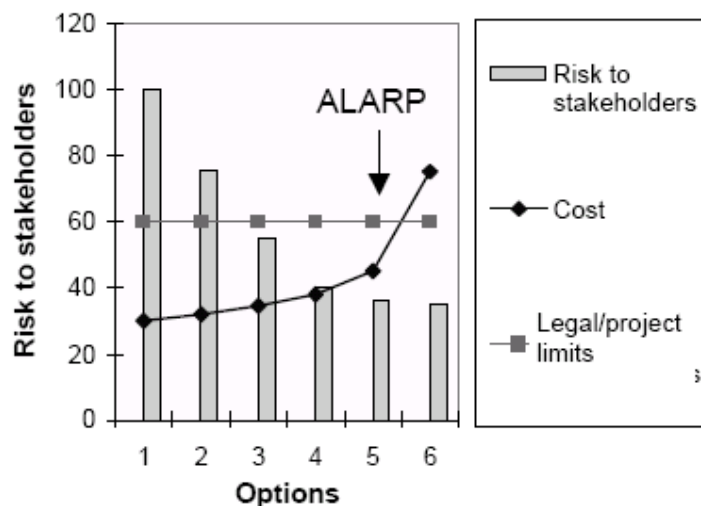
5.0 INSTRUCTIONS

5.1 Risk Reduction to ALARP level

During the Hazard Identification stage of the HEMP, a list of hazards will be identified and these will be assessed using the Risk Assessment Matrix (RAM), see Attachment 7.3.

Risks will always have to be reduced to a level that is both tolerable and As Low As Reasonably Practicable (ALARP); however, if the risk falls within the light and dark shaded areas of the [Risk Assessment Matrix](#) a documented demonstration is required. ALARP can be demonstrated if alternatives have been considered and it is concluded that further risk reductions are impracticable or the costs thereof are grossly disproportionate to the improvements gained.

The standard target for managing risk will be reduction to the ALARP level. Risk tolerability criterion will be established considering appropriate guidelines (e.g. regulatory requirements, project standards and guidelines, Client corporate policy and objectives, liability control, etc). This will be assessed by the project manager and demonstrated using the template included as Attachment 7.1 and [7.2](#) to this document.



The principle of ALARP determination is shown above. The risk must be contained at a tolerable level i.e. below an unacceptable project or legal maximum level, but without incurring high cost for only marginal improvement. The justification of a favorite option may be difficult and demonstrating that it constitutes ALARP may require consideration of fundamentally different options to provide assurance that the most appropriate option has been chosen. It requires consideration of all the hard and soft issues related to the range of possible options and a judgement decision based on knowledge of their associated risks and costs.

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5.2 Timing for ALARP

ALARP should be considered through all stages of the design. The ALARP worksheets (see attachments 7.1 [and](#) 7.2) will be completed by the BDEP Design Engineers who will provide the HEMP Review documents which detail those hazards where a demonstration of ALARP must be provided. The ALARP worksheets should be available and reviewed before commencement of the HAZOPs.

Some HEMP reviews will be carried out in the detailed design and construction phase. The SECL will complete ALARP Worksheets (attachments 7.1 and 7.2) for any areas, identified during these reviews, where ALARP shall be documented.

5.3 ALARP Review Process Steps

The following identifies the steps to be taken to satisfy the requirements of the ALARP procedure:

- Step 1 Identify where demonstration of ALARP must be documented from the reports generated from the **HEMP 1 and 2 study reports**. These are being produced for all process units, offsites and utilities. The HEMP Hazard Identification process is described in HEMP Procedure. Other situations may develop during the course of design, which require consideration of ALARP and these should also be included.
- Step 2 Complete the ALARP Worksheets in Attachments 7.2 for each Unit. In particular, define whether the identified hazard is a **Generic** or **Specific** one. For generic hazards an ALARP review will be centrally organized which will generate reference documentation. This will avoid duplication of effort in considering ALARP for the same hazard. For specific hazards it is important that **other measures, which could contribute to risk reduction but may be excessively expensive**, are listed (in section 5, Part D of Attachment 7.2).

Subsequently during ALARP review, they can be either dismissed because of excessive cost/limited benefit or considered further. When developing ALARP it may be useful to categorize chemicals according to the 'DEP Categories' used in the Health Design Criteria.

- Step 3 The ALARP team either individually or via a meeting will review the worksheets (ie completed templates – attachment 7.2) for each Unit. This should ideally be completed during the initial PEFS review. However, as a minimum the ALARP review must be performed prior to HAZOPs to allow for agreed safety improvements to be incorporated prior to HAZOP study. [Attachment 7.1](#) summarizes the study with required signatures through the review and change approval stages. In deciding whether to recommend a design change, the ALARP team may find the attached nomographs of value (Attachment 7.5) in carrying out a cost/benefit analysis and ranking options. Use of these should be self-explanatory, but starts with the determination of Risk Score by locating a

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point on the tie-line, based on likelihood and exposure, and projecting through the appropriate Possible Consequences to determine the score. A similar technique is used on the Cost Effectiveness nomograph to determine a Justification Factor.

- Step 4 Identify areas where further ALARP study may be required and review these areas with the appropriate ALARP Team.
- Step 5 Close-out the ALARP actions raised during the HEMP studies with the appropriate ALARP documentation. Submit recommended changes to project designs/specifications to the Project Manager for approval (and via him to the Client). Ensure that documentation is registered with document control.

These process steps are illustrated in flowchart form in Attachment 7.4. The purpose of this procedure is to document where ALARP has been applied in the higher risk areas ([Risk Assessment Matrix](#) 3C, 4 & 5), but also to encourage engineers to continuously generate ideas for areas of improvement to Health, Safety or the Environment.

6.0 REVISION HISTORY

Rev	Date	Page	Revision status
0	2004. 7. 1	All	- Newly prepared as HSE management - Original Dept. : Process Engineering Team - Prepared by : Henry Sung - Checked by : Jae-chul Ro, Jong-Heon Park, Eui-Duk Lee - Approved by : Chan-Sul Jung
1	2010. 11. 20	All	Document number revision - Prepared by : Y.S. Seo - Reviewed by : H. Sung, J.C. Ro, H.H. Kwak, M.H. Oh, S.U. Hong - Approved by : E.D. Lee
<u>2</u>	<u>2013. 07. 01</u>	<u>All</u>	Revised as regular update - Prepared by : M.H. Kim - Reviewed by : W.H. Cho, D.W. Kim - Approved by : S.B. Lee

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7.0 ATTACHMENTS

ATTACHMENT 7.1 HEMP ALARP ASSESSMENT SUMMERY

HEMP ALARP ASSESSMENT SUMMARY	
Plant:	HEMP Doc. No.:
ALARP Doc. No. (from Safety Group):	

PART A Summary of Review

1. No. of proposals recommended for development/inclusion.		2. No. of proposals NOT recommended for development/inclusion.	
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Proposals recommended FOR Development			
No.	Description	Comments on justification etc	Implementation by

Proposals NOT recommended for Development	
Description	Reasons for not developing

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PART B Signatures

Originator		Comments
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HEMP ALARP ASSESSMENT SUMMARY		
Plant:	HEMP Doc. No.:	
ALARP Doc. No. (from Safety Group):		
Date		

SECL Authorized Safety Engineer		Comments
Date		

Project Manager		Changes Approved/NOT Approved
Date		

Client Authorized Engineer		Agreed
Date		

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ATTACHMENT 7.2 HEMP ALARP ASSESSMENT TEMPLATE

HEMP ALARP ASSESSMENT TEMPLATE	
Plant:	HEMP Doc. No.:
ALARP Doc. No. (from Safety Group):	
Unit:	Unit No.:

PART C Unit Overview

1. List all the hazardous chemicals identified in the ALARP column of Table 1 of the HEMP (Stage 1 & 2) document for this Unit.	
2. List hazards of a physical nature associated with this Unit identified in the ALARP column of Table 2.1 of the HEMP.	
3. List Hazards related to Organization or Person Specific Aspects identified in the ALARP column of Table 2.2 of the HEMP	

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HEMP ALARP ASSESSMENT TEMPLATE	
Plant:	HEMP Doc. No.:
ALARP Doc. No. (from Safety Group):	
Unit:	Unit No.:
PART D: Hazard Description	
Chemical: X	Specific/ Generic
1. Description of Hazardous Chemical or situation (reference if generic)	
2. Under what conditions is the chemical/hazard released?	
3. What barriers are in place in the design to prevent the hazard from being released?	
4. What design (and other measures) are being taken to reduce the consequences of the release of the hazard? (Include inherent safety measures, e.g. reduction of the inventory of chemical stored).	
5. List any additional barriers and/or alternative measure that could be added, but may not be cost effective, to reduce the hazard. ie. potential safety, health or environmental improvements to this design, with order of magnitude cost and assessment of risk reduction.	

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HEMP ALARP ASSESSMENT TEMPLATE	
Plant:	HEMP Doc. No.:
ALARP Doc. No. (from Safety Group):	
Unit:	Unit No.:
PART D: Hazard Description	
Chemical: Y	Specific/ Generic
1. Description of Hazardous Chemical or situation (reference if generic)	
2. Under what conditions is the chemical/hazard released?	
3. What barriers are in place in the design to prevent the hazard from being released?	
4. What design (and other measures) are being taken to reduce the consequences of the release of the hazard? (Include inherent safety measures, e.g. reduction of the inventory of chemical stored).	
5. List any additional barriers and/or alternative measure that could be added, but may not be cost effective, to reduce the hazard. ie. potential safety, health or environmental improvements to this design, with order of magnitude cost and assessment of risk reduction.	

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ATTACHMENT 7.3 RISK ASSESSMENT MATRIX

Severity	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Environment	Reputation	A	B	C	D	E
					Never heard of in industry	Heard of in.... industry	Incident has occurred in our Company	Happens several times per year in our Company	Happens several times per year in a location
0	No health effect/injury	No damage	No effect	No impact	Manage for continuous improvement				
1	Slight health effect/injury	Slight damage	Slight effect	Slight impact					
2	Minor health effect/injury	Minor damage	Minor effect	Limited impact					
3	Major health effect/injury	Localised damage	Localised effect	Considerable impact	Incorporate risk reduction				
4	PTD or 1 to 3 fatalities	Major damage	Major effect	National impact	measures & demonstrate				
5	Multiple fatalities	Extensive damage	Massive effect	International impact	ALARP				
					Intolerable – investigate alternatives.				

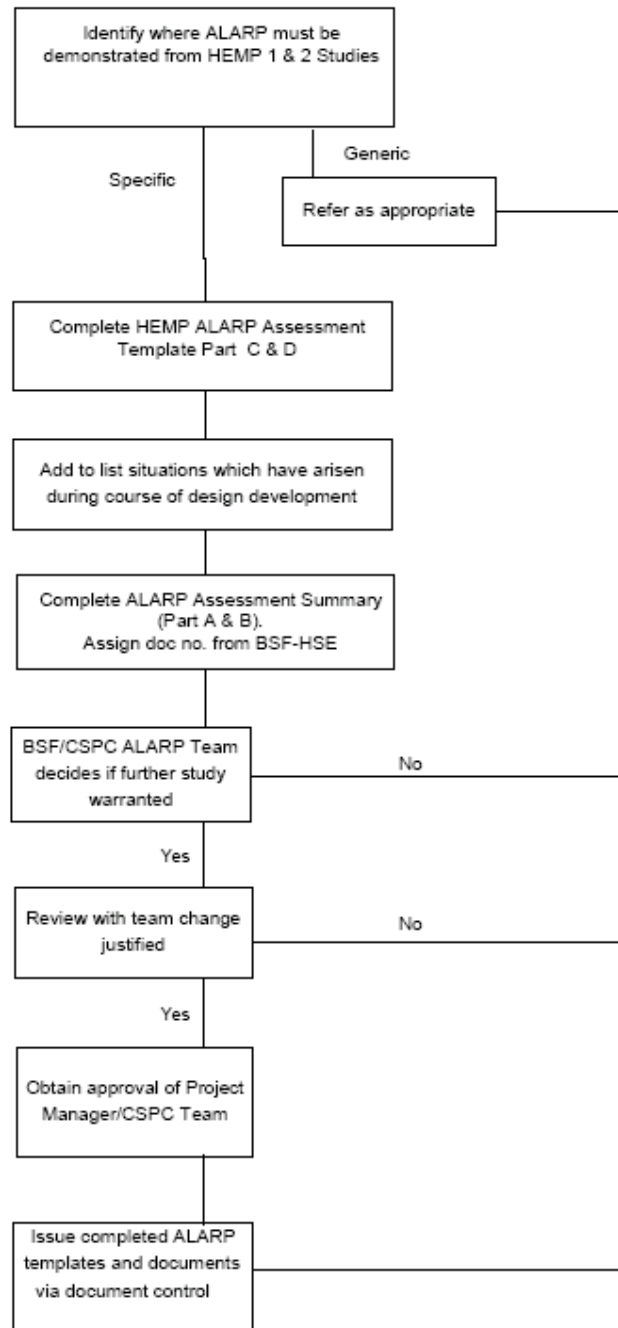
Consequence = potential consequence of an incident

Likelihood = previous occurrence of this consequence due to this type of incident

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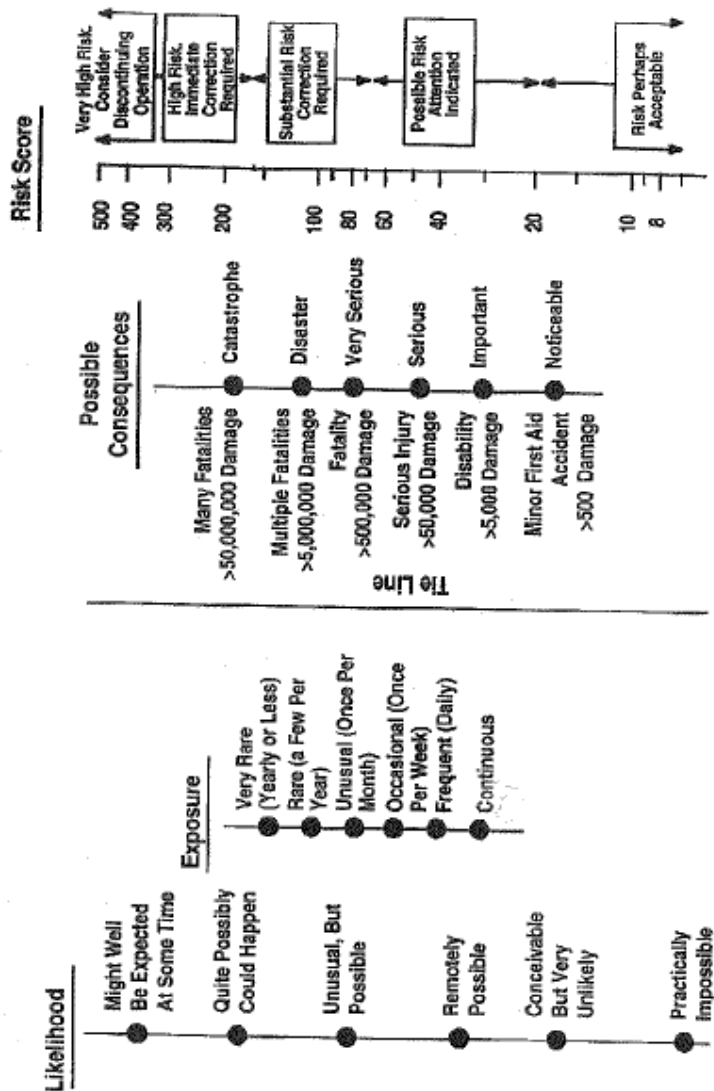
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ATTACHMENT 7.4 ALARP FLOWCHART



ATTACHMENT 7.5 RISK SCORE ANALYSIS AND COST EFFECTIVENESS ANALYSIS

RISK SCORE ANALYSIS



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ATTACHMENT 7.5(contd.)

COST EFFECTIVENESS ANALYSIS

