

Integrated Revalidation HAZOP/SIL Study: Lessons Learned

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Ju'aymah NGL Fractionation Plant, Saudi Aramco

- **Background**
- **Life Cycle Model**
- **Study Scope & Scheme**
- **Lessons Learned**
- **Summary**

- **Process Hazard Analysis:**
 - Hazard evaluation that identifies and analyzes the significances of hazardous situation associated with a process or activity.
- **What is Revalidation?**
 - Updating the results of initial PHA and identify, evaluate and attempt to control any newly introduced hazards.
- **Industry Practices:**
 - Initial PHA is typically performed during design stages.
 - Recent trends mandates frequent updates.
- **Why Revalidation?**
 - Changes on Field, Equipment & Personnel

Life Cycle Model



Design



Construction



Operate & Maintain



Decommissioning

Risk Assessment

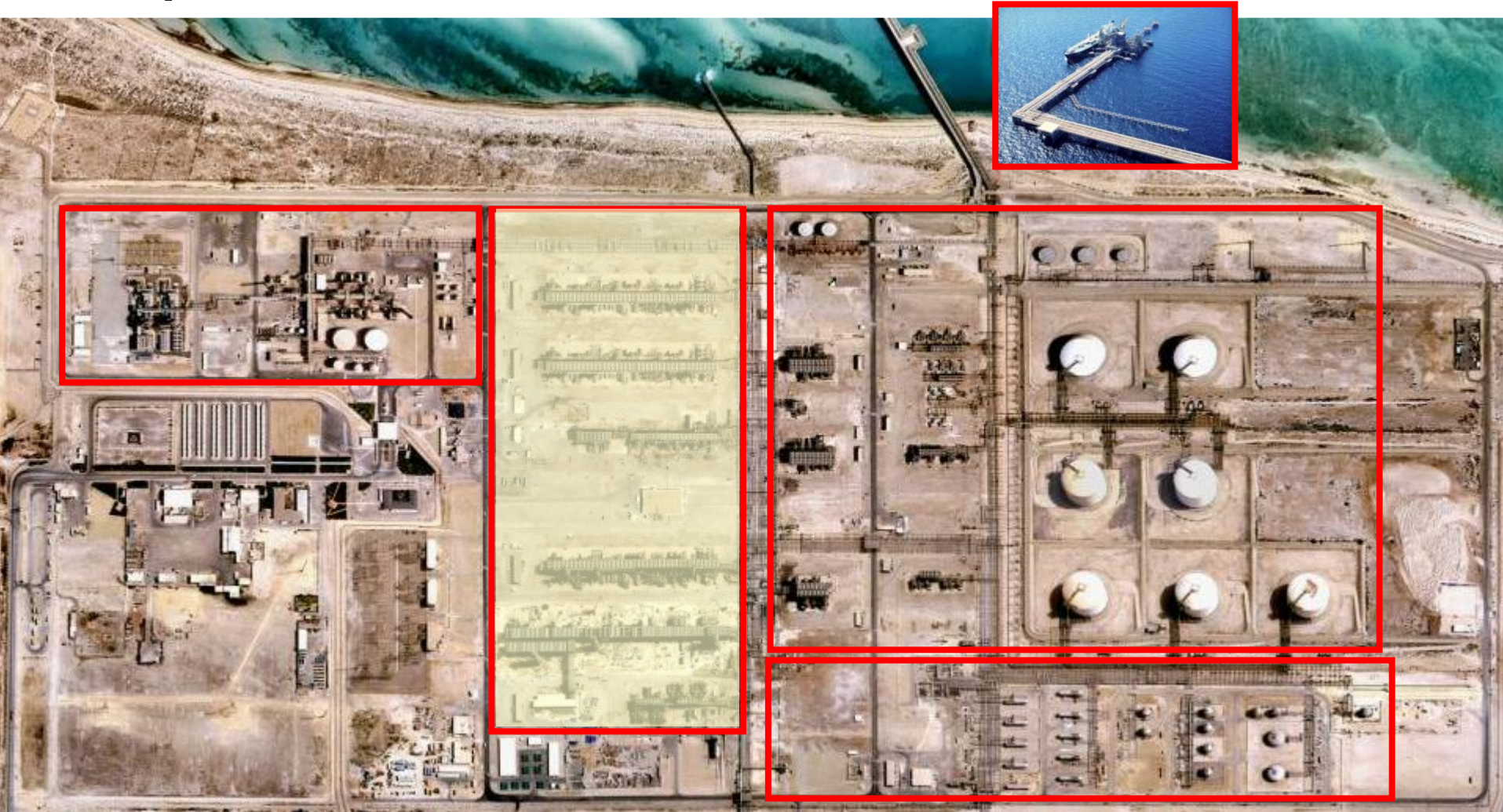
Asset Integrity

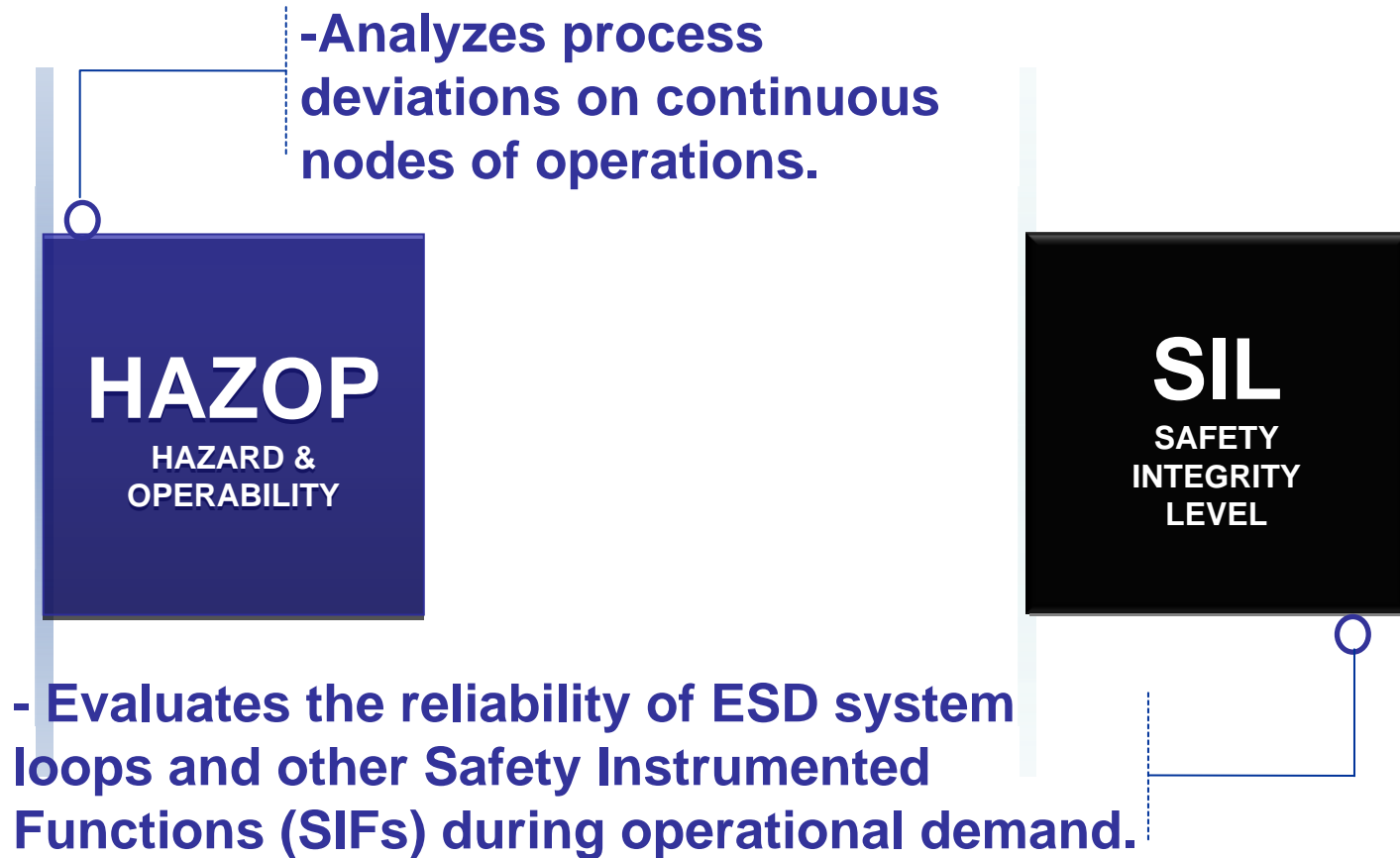
“A Process Hazard Analysis shall be performed on individual process node within a unit and on the entire unit at least every 5 years”




Ju'aymah NGL Fractionation

- Scope & Scheme:





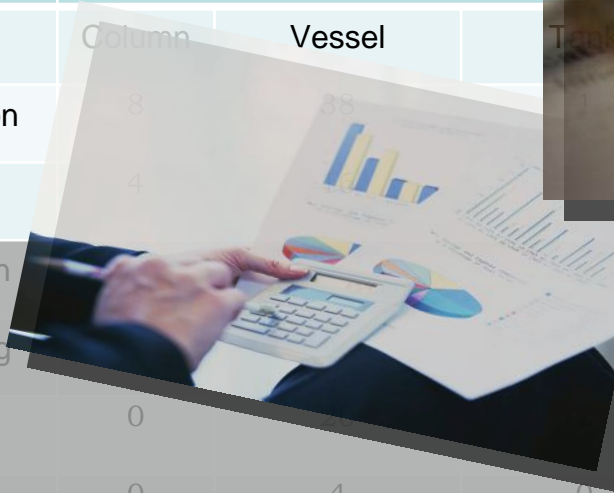
JNGLF Study

- **Consultant:** Consultant: ERSG, Australia 
- **Scope:** HAZOP & SIL for 3 Fractionation modules, Rerun units and Auxiliary systems.
- **Total Process Nodes** 35 Nodes
- **Start:** October 3rd, 2009
- **Finish:** November 5th, 2009
- **Venue:** JNLGF Training building
- **Team:** 10 full-time & 3 part time
- **Daily hours:** 6-8 hrs

Lessons Learned

- Revalidation shall be business-driven.
- Process nodes estimation defines the roadmap.

| | Primary | | Duplicates | |
|-------------------|---------|--------|------------|------|
| | Column | Vessel | Column | Tank |
| Plant | | | | |
| NGL Fractionation | 8 | 38 | 3 | 0 |
| Rerun | 4 | | 2 | 0 |
| Surge & Injection | | | 6 | 0 |
| Product Handling | | | 4 | 0 |
| Off-shore | 0 | | | 6 |
| Utilities | 0 | 4 | 0 | 0 |



45 PFDs
200 P&IDs

Lessons Learned

Preparation

Schedule

Methodology

Training

RMP

- Revalidation shall be business-driven.
- Process nodes estimation defines the roadmap.
- Success is determined by teamwork.

Project Manager

Team Leader

Loss Prevention
Engineer

(2) Control &
System Engineers

(2) Operations
Engineers

Unit Operator

Maintenance
Supervisor

Instrument Engineer

Sr. Instrument
Engineer

(2) Sr. Operations
Engineers



Lessons Learned

- Revalidation shall be business-driven.
- Process nodes estimation defines the roadmap.
- Success is determined by teamwork.
- Key engineering documents shall be available.



Lessons Learned

- Clear study schedule helps to streamline activities.
- Daily plan & objectives supports team to focus.
- Spotting concerns engages management support.



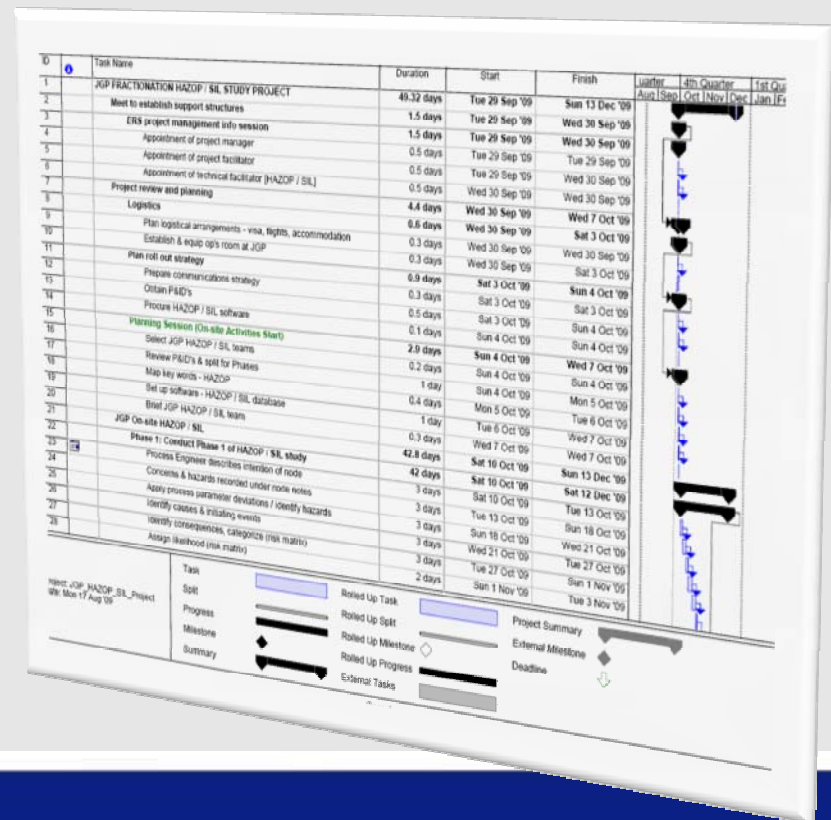
4.0 De-ethanizer Refrigerant System Unit:

The De-ethanizer Refrigerant System Unit will be broken down into the following Process Sub-Units – which will each undergo a detailed HAZOP guide word review:-

HAZOP Study Node no: 2.0

| Node Number | Node description | Reference F&ID |
|-------------|---|----------------------------------|
| Node 2.1 | Refrigerant flash drum R84-D-104 | R84-A-NA-B44995 Sheet no: 006 |
| Node 2.2 | Refrigerant compressor K.O drum R84-D-103 | R84-A-NA-B44995 Sheet no: 006 |
| Node 2.3 | Refrigerant compressor R84-K-101 process feed line | R84-A-NA-B44995 Sheet no: 007 |
| Node 2.4 | Refrigerant compressor R84-K-101 process discharge line | R84-A-NA-B44995 Sheet no: 007 |
| Node 2.5 | Refrigerant compressor R84-K-101 steam turbine steam inlet / outlet | R84-A-NA-B44995 Sheet no: 007 |
| Node 2.6 | Refrigerant accumulator R84-D-102 | R84-A-NA-B44995 Sheet no: 008 |
| Node 2.7 | Refrigerant condenser R84-E-104 | R84-A-NA-B44995 Sheet no: 008 |
| Node 2.8 | Refrigerant economizer R84-E-105 A/B | R84-A-NA-B44995 Sheet no: 008 |

Note: This includes recycle line to refrigerant flash drum R84-D-104



Lessons Learned

- Unit breakdown avoids potential duplicates.
- Opportunities for optimization shall be invested.
- Visible P&ID for all team sets review unity.
- SIL integration minimized 50% of time and efforts.

De-ethanizer

De-ethanizer Refrig
system

ADIP Extraction

MEROX Treatment

LPG Dehydration

NG Decolorization

Rerun Auxiliary Units

Screening

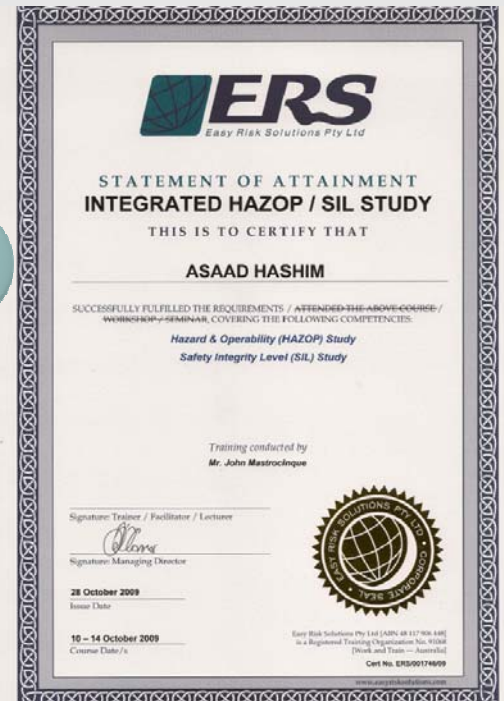
Initial
Assessment

Validation



Lessons Learned

- Advantage for participants when trained on basics.
- Discussion participation shall be fostered.
- Opportunity for new engineer's learning.



Lessons Learned

- Report value is how helpful for Implementation team.
- Attention is to be given for procedural systems.

NDT Inspection

Turnaround &
Inspection (T&I)

LEL Detection layout

Fixed fire
protection layout

Operation Instruction
Manual (OIM)

Operator's training

ESD Procedures

Instrumentation &
Rotating equip. PM

Exception of
specific failure

Rational behind
optimization

Common
industrial trends

Integrated Hazop/Sil Study
Ju'aymah NGLF Plant

05 November 2009

John Mastrocinque - HAZOP/SIL Facilitator
Wayne Basson - Project Manager

ERSG
RISK MANAGEMENT DIVISION

*Risk Mitigation Plan

Lessons Learned

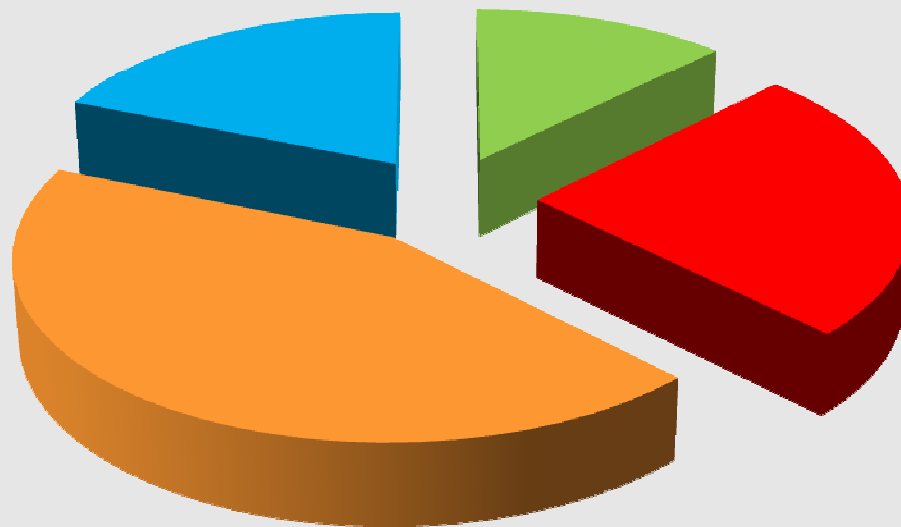
- Report value is how helpful for Implementation team.
- Attention is to be given for procedural systems.
- Categorizing action plans addresses RMP priority.

| | | Likelihood (that an injury will occur from the hazard) | | | | |
|----------|---------------------------------------|---|----------------------------|---------------------------|----------------------------|-------------------------------|
| | | Frequent > 1 per year | Occasional 1 in 5 years | Possible 1 in 30 years | Uncommon 1 in 100 years | Very rare 1 in 1000+ years |
| Severity | Catastrophic | High | High | | High | Medium |
| | Fatality or Disability Injury | High | High | | Medium | Medium |
| | Minor (Loss Time Accident) | High | Medium | | Medium | Low |
| | First Aid required | Medium | Medium | | Low | Low |
| | No injury or minor first aid required | | Low | | | |

*Risk Mitigation Plan

Lessons Learned

- Report value is how helpful for Implementation team.
- Attention is to be given for procedural systems.
- Categorizing action plans addresses RMP priority.



■ Info Items ■ "A" Priority ■ "B" Priority ■ "C" Priority

*Risk Mitigation Plan

SIL Validation

- Refrig. compressor (DeC2)
- Critical & non-critical SD
- Total of "5" SIL 1 rating
- Acceptable risk level

- PHA revalidation would lose value if not driven by business-objectives and management support.
- Ju'yamah NGL's scheme of integrated PHAs was successful to optimize time, efforts and assigning RMP.
- PHA is an opportunity for risk reducing and process learning specially for new engineers.
- Findings of retroactive SIL on existing facilities are likely to be minimum unless major upgrade occurs.
- Risk Mitigation Plan should be prioritized either qualitatively or quantitatively for implementation.

Thank you

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