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Heavy Oil

Controlled Document

Quest CCS Project

Technical Integrity Verification Plan & Procedure

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Summary

Technical Integrity Verification Plan for Quest CCS Project

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1. INTRODUCTION

1.1. Association with Global and Project Processes

Delivery of Technical Integrity requires that all systems and their subsidiary components critical to managing major and high risk hazards be properly designed, procured, built, installed, tested and maintained to ensure that the risk of a major or high risk accident event is As Low As Reasonably Practicable (ALARP). These critical components are designated as Safety Critical Elements (SCEs) and the performance criteria and documented plan for assuring an SCE will be available and perform as needed is called the Performance Standard (PS) for that SCE. The document that describes the contingency actions that Scotford operations must take when a specific SCE does not meet its performance standard is called the Manual Of Permitted Operations (MOPO) or the equivalent document used at the Scotford site.

Technical Integrity on a project is delivered when Performance Standards for SCEs have been produced and implemented. This document provides the plan and procedure for delivering Technical Integrity on the Quest CCS project. It covers Execute phase. This plan is intended only to deliver Technical Integrity, including all information and systems needed to maintain Technical Integrity after project handover. The ongoing maintenance of Technical Integrity is the responsibility of the asset (Operations). The operations organization is represented on the project by the Operations Implementation Team (OIT), which ensures that the operating asset has the information required to maintain Technical Integrity, and will provide critical input and guidance to the remainder of the project team.

Design and functional requirements of all identified Performance Standards will be incorporated into the facility design. This is further addressed in Basic Design Engineering Package.

1.2. Scope and Purpose

The Quest CCS Project Developments Project has prepared this TIV Plan for the design, construction and installation of ;

- Quest CCS Capture
- Quest CCS CO2 pipeline
- Quest CCS wells (down hole)

The purpose of this TIV Plan is to provide a focused process for assuring the technical integrity of Safety Critical Elements for each of the assets. This assurance is achieved by identifying the appropriate SCEs, defining their performance standards (PS) and carrying out verification activities to ensure that the performance standards are met in each of the project phases.

A secondary objective is to provide operating integrity process at the Scotford Upgrader based on the Standard EP Technical Integrity Framework requirements. This plan explains the process for integrating Quest CCS Project TIV activities into Operations Integrity Management.

1.3. Background

Projects have historically ensured technical integrity utilizing numerous independent and interdependent methods. The primary assurance processes utilized in the Quest CCS Project Developments Projects consist of:

1. Quality Assurance and Control – A well established methodology normally administered under the ISO 9000 industry standard guidelines. Typically the Company as well as the major Contractors will administer their own interdependent QA/QC programs.

2. Project Assurance – The Project will subscribe to the Discipline Control Assurance Framework. This framework consists of a structure of deliverables and assurance reviews mandated by Shell. The framework identifies the discipline specific (process, instrumentation, HSE, etc.) deliverables to be completed during each project phase. Quest has developed a Project Control Assurance Plan (PCAP) to implement DCAF.

3. Regulatory Verification Requirements – These requirements are administered by regulatory agencies and are host-country specific. For this Project, these requirements for pressure vessels are enforced by Alberta Boilers Safety Association (ABSA) for pressure vessels and the Energy Resources Conservation Board (ERCB) for the pipeline.

Technical Integrity Verification is intended to supplement these three comprehensive initiatives.

1.4. Value Added Approach to TIV

The key feature of the TIV Plan is that it shall add value to the overall Project by providing an additional level of assurance (above and beyond those processes described in the preceding section) to those elements that can contribute to a major accident. Value enhancement shall be achieved by:

1. Narrowing focus on specific areas that merit further verification. This approach requires a focused definition of what an SCE is and ensuring that the definition of safety criticality is closely followed.

2. Taking credit for the numerous verification activities provided by the traditional assurance processes and eliminating duplication of work. Rather than undertaking verification of everything related to the SCEs, where appropriate, credit for existing planned activities (e.g. design reviews, inspections of equipment, etc.) shall be taken. Therefore, the verification activities will cover areas where existing project activities do not adequately address the performance criteria associated with the SCEs. Such as - where existing verification activities do not address a specific performance criteria, or where the existing verification activities may be insufficient due to the criticality of the element under review.

Consequently, verification activities will not just replicate existing assurance activities but rather focus on higher risk areas or fill gaps in the existing activities. Application of a TIV Plan which focuses on adding value shall ensure the effort is applied appropriately, i.e. PSs for SCEs already provided with adequate assurance can be incorporated, while key PSs for SCEs that provide a critical role in the management of HSE are appropriately scrutinized.

2. TECHNICAL INTEGRITY

2.1. Technical Integrity within Project Phases

Technical & Operational Excellence (T&OE) describes technical integrity as a condition for which, under specified operating conditions, the risk of failure occurring which would endanger the safety of personnel, the environment or asset value is tolerable and has been reduced to as low as reasonably practicable. TIV is achieved by establishing, delivering and maintaining the integrity attributes throughout the life cycle of the project.

Technical Integrity of Facilities and Wells is established through:

- Design Integrity during the Define-Execute phases of ORP

Technical Integrity of Facilities and Wells is delivered through:

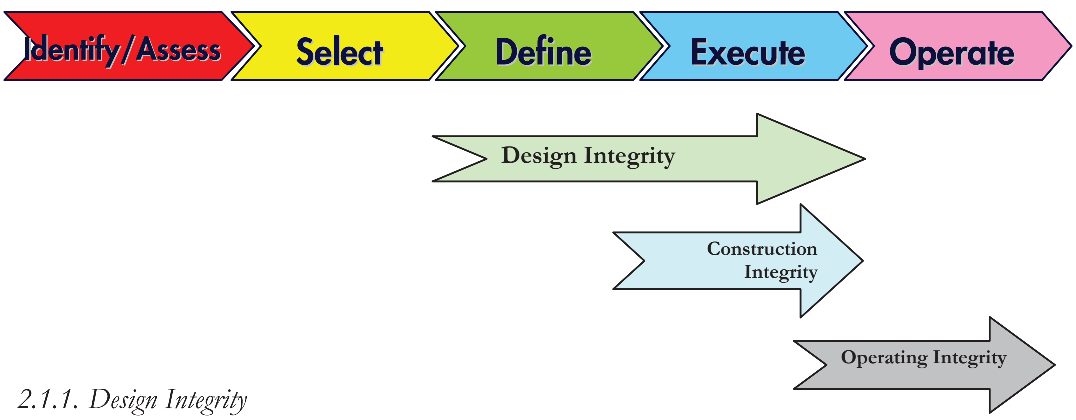
- Construction Integrity during the Execute phase

Technical Integrity of Facilities and Wells is maintained and improved through:

- Operating Integrity during the Operate phase

This is depicted in Figure 2.1.

Figure 2.1 Technical Integrity in Project Phases



2.1.1. Design Integrity

Design integrity – when referring to an element, ensures that "it will work in theory". An asset has design integrity when:

- The SCEs are identified according to pre determined criteria,
- Performance Standards, comprising of functionality, reliability/availability, are established for each SCE. The performance standards may be supplemented by the basis of design , specifications and data sheets.
- Physical behavior relevant to functional performance has been conservatively modeled and analyzed. Examples of this include engineering design modeling and analysis of the physical behavior such as process simulation.
- Possible functional failure modes have been considered consistent with operating and requirements. Examples of this include performing various HEMP studies such as HAZOP.

2.1.2. Construction Integrity

An asset's construction integrity refers to it being procured, fabricated, constructed and installed in a manner that validates design integrity objectives are being met prior to handover. Construction Integrity is achieved through the completion of auditing, inspection, testing, witnessing and examination activities to ensure that the criteria set by the performance standard of each SCE is met.

2.1.3. Operating Integrity

Operating Integrity relates to the assets being operated, maintained, and modified in accordance with performance standards established during the design phase. The transition between Design/Construction Integrity and Operating Integrity is achieved by incorporating the SCEs and their associated performance Standards into the Maintenance Management System and Operational Readiness Process. At this juncture, the operating business unit may wish to also include other elements that are not SCEs but do affect the productivity of the facility.

Operating Integrity is briefly described in this document but is not within the scope of work as it is governed by separate standards.

3. TECHNICAL INTEGRITY VERIFICATION

The process of demonstrating Design and Construction Integrity for the Safety Critical Elements is known as Technical Integrity Verification. The Quest CCS Project has created a plan (TIV Plan) to manage TIV throughout the various disciplines and phases of the Project The objective of this TIV Plan is to provide the framework for developing the verification activities and schedule for these activities to be performed during the define and execution phase of the project. The TIV Plan consists of four parts:

1. Identifying SCEs.
2. Developing PSs for the SCEs.
3. Developing the verification scheme to ensure that the PSs for the SCEs implemented.
4. Scheduling the activities in the verification scheme to ensure adequate notification is provided to the verification party. This will ensure that technical and logistical preparations are complete prior to the scheduled activity.

These four elements are closely linked and provide the mechanism for ensuring the design intent of the facilities are understood and adhered to in the operations phase.

3.1. Safety Critical Elements

Any structure, equipment, system or component part whose failure could cause or contribute substantially to a *Major Hazards* is considered an SCE. SCEs also include those items that are crucial to the prevention, control or mitigation of *Major Hazards*.

Major Hazards as identified in the Shell HSE Risk Assessment Matrix are those potentially having high risk or severity level 5 consequences on the Risk Assessment Matrix. For TIV purposes only, these consequences are limited to safety and environmental. When plotted on the Risk Assessment Matrix, *Major Hazards* will plot in the red zone or in the A5 or B5 squares. See Figure 3.1 below.

Figure 3.1: Definition of Safety Critical Elements

SEVERITY	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Environment	Reputation	A Never heard of in the Industry	B Heard of in the Industry	C Has happened in the Organisation or more than once per year in the Industry	D Has happened at the Location or more than once per year in the Organisation	E Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No impact					
1	Slight injury or health effect	Slight damage	Slight effect	Slight impact					
2	Minor injury or health effect	Minor damage	Minor effect	Minor impact					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate impact					
4	PTD or up to 3 fatalities	Major damage	Major effect	Major impact					
5	More than 3 fatalities	Massive damage	Massive effect	Massive impact					

SCE's consist primarily of hardware equipment (e.g. vessels, instrumentation,) but can also constitute activities (e.g. procedures, tasks) that influence the prevention or recovery from a major hazard.

Narrowing the definition of a SCE in the context of TIV is deliberate and does not imply that all other high asset/reputation risk or medium to low risks are in any way neglected. The focus on Safety and Environmental is warranted for the following reasons:

- Reputation Risks are most effectively managed by the Project Risk Register and are often beyond the circle of influence of HSE and discipline personnel.
- Asset Risks, including the loss of production, is managed utilizing other tools such as Reliability/Availability/Maintainability Assessments. These tools define the production critical equipment as well as the mitigation strategies, such as process redundancy and spare equipment philosophy.
- Including all HSE risks can quickly result in an exponential expansion in the number of SCEs. The additional scope dilutes the importance of what is truly safety critical and create an undue burden that may ultimately compromise providing the appropriate level of assurance.
- Experience in other Projects has shown that all-inclusive TIV Plans are fraught with technical and organizational complexity which prevents them from being as effective as originally envisioned.
- Other high risk or severity level 5 consequences will still be identified in the Hazard and Effects Register and administered in accordance with the RAM. Furthermore, the three assurance mechanisms described in Section 1.3 still apply to Reputation and Asset Risks as well as to lower risk (e.g. yellow risks) hazards

3.2. Identification

The Quest CCS Hazard and Effect Register is the primary source of identifying major hazards. For each major hazard a SCEs listing is created utilizing using Bowties.

The HSE Team Lead in association with Operations and other Engineering Disciplines will be responsible for identifying the SCEs.

3.3. Performance Standards

A performance standard is a statement expressed in qualitative or quantitative terms of the performance against which the SCEs can be assessed. Therefore, PSs provide an acceptance criteria, for the assessment and demonstration of the SCE's ability to prevent or mitigate a Major Accident Hazards throughout the lifecycle of the Project.

Performance standards should contain precise information relating to the SCE's functionality, availability/reliability. Each of these elements are discussed individually.

1. Functionality - An expression used to define what the system / equipment is required to do in order to serve as the prevention or protection mechanism from a Major Hazard. An example would be to define the leak rate requirement for an emergency isolation valve.
2. Availability / Reliability - Availability is the fraction of time the equipment is required to be operable in order to perform its intended function. For example a firewater pump must be available 100% of the time, that is one reason there is often more than one pump and why dual energy sources are provided.

   Reliability the probability that the system or item of equipment will perform its intended function when required to do so. Reliability of safety critical instrumentation is often expressed by its SIL level.

3.4. Verification Activities

Once the PSs have been defined, the verification activities associated with ensuring that the performance criteria is met needs to be developed. Verification activities may constitute:

- Review: Check of principles, methodology and results.
- Assess: Detailed check of design (e.g. calculations).
- Inspect: Check to confirm that construction / fabrication has been carried out in accordance with design and specification.
- Test: Confirmation that testing has been carried out as part of the verification process.
- Witness: Confirmation that testing has been carried out in accordance with contract documentation (e.g. FAT).

Verification activities will be project-phase dependent (e.g. fabrication, commissioning, etc.) and may be performed by Company personnel, contractor personnel, third party personnel or any other entity that is deemed appropriate by the TIV Plan.

The level of technical competence required by those conducting verification activities is of importance. Where verification activities are conducted by Company personnel, the competence of particular individuals to carry out these activities must be in accordance with their TAF level. For those activities not performed by Company personnel, the competence of those specific individuals may be assessed by their respective job function qualifications (e.g. CVA representatives).

3.5. Performance Standard and Verification Matrix

A PS and Verification Matrix will be prepared for every SCE identified. The Matrix will define the performance criteria as well as the outline verification activities and timing of those activities. A blank template has been prepared and is included in Section 6.1. For each of four performance elements discussed above, the template provides for the elaboration of the following criteria:

- **SCE Description** - A narrative identifying the Safety Critical Element
- **Performance Standard Goal** - A description of the role and intent of the SCE in the context of major hazards
- **Boundaries**- A description of boundaries of the SCE (i.e. where it starts and where the it stops; what is covered, what is not)
- **Criteria -** An expression in qualitative or quantitative terms of the performance required from the SCE. This can be used as the basis of verification in terms of Functionality, Reliability/Availability, to ensure that the SCE is suitable and remains fully functional throughout the lifecycle of the Project.
- **Verification -** Describes the audit type activities required to ensure that the performance criteria has been verified. Verification activities shall be defined for the design and construction (includes procurement, construction/fabrication, installation and commissioning) and will often be applicable to both.

To facilitate populating the project specific performance criteria, a generic listing of from previously completed projects is included in Section 6.2.

4. ROLES AND RESPONSIBILITIES

4.1. Project Manager

The Project Manager is accountable for compliance with the technical integrity verification requirements for the project until project handover. Thereafter, the Asset Manager takes this accountability.

4.2. HSE Lead

The HSE Lead shall be the single focal point for identifying safety critical elements. The HSE Lead is responsible for the overall planning and coordinating with the various disciplines to ensure that the Performance Standard are being generated in a consistent manner.

- Ensuring that this TIV Plan is created, approved and implemented.
- Ensuring the identification of Quest CCS Project specific SCEs.
- Obtaining concurrence with Quest CCS Project OIT engineering lead on the list of SCEs.
- Assisting in the development of verification activities (e.g. defining criteria from HEMP studies).
- Coordinating with the various disciplines to ensure that the Performance Standards are being generated in a consistent manner.
- Liaise with the disciplines engineers to manage scope, progress and resolution of issues.

4.3. Discipline Engineers

Discipline engineers are primarily responsible for populating the performance standards for each of the SCE's and for defining and carrying out all the verification activities. Specifically, discipline engineers responsibilities include:

- Developing the performance standards utilizing the Project PS template
- Reviewing or developing the verification activities.
- Actioning any agreed observations or non-conformities identified from the verification activities.
- Producing verification reports and reporting verification completion against discipline scope.
- produce the verification matrix for their PS's

4.4. Quality Team Lead

The Project Quality Team Lead is responsible for ensuring that the verification activities are being completed as scheduled and in a manner consistent with the intent described in the performance standard.

- Ascertain that the discipline engineers have completed the verification activities for the SCEs in a manner consistent with the verification scheme defined in the PSV matrices .
- Carrying out, or causing to be carried out, the verification activities and reporting the results of these verification activities.
- Establishing and maintaining a system for the acquisition of records of verification activities and other correspondence relating to verification
- Ensuring that a system for the acquisition of records of verification activities and other correspondence relating to verification is established and maintained. This is to include any non-conformance findings and the appropriate response to such.
- Publish a TIV Verification Report.

4.5. Maintenance & Engineering Manager

The OIT Engineering Lead will be responsible for the following:

- Reconcile differences between the Quest CCS Project specific SCEs and Heavy Oil SCEs.
- Logging the list of SCEs in the Asset Register.
- Modifying the minimum operations and maintenance requirements documented in the Master Task Lists.
- Concurrence with the reconciliation between Quest CCS Project specific SCEs and Scotford SCEs, which may include the addition of new SCEs to Scotford.
- Concurrence with the differences between the Scotford Performance Standards and the Quest CCS Project specific Performance Standards.
- Ensuring that the appropriate Technical Authorities in Scotford review any proposed changes.

5. IMPLEMENTATION

The development of the verification plan shall firstly require the identification of SCEs (see Section 3.2), development of the PSs for the SCEs (see Section 3.3), and development of the requirements for verifying that the required PSs for the SCEs shall be achieved (see Section 3.4).

Once the Verification Matrices are developed for the PSs then the verification plan is achieved by scheduling the required verification activities in line with the project schedule.

The scheduling of verification activities is the responsibility of the of the Discipline Engineers. The production of updated verification schedules and progress reporting is the responsibility of the Assurance Lead.

An Observation shall be made whereby, those conducting verification activities consider certain actions could improve the integrity of equipment or of the maintenance process. This shall be raised purely for information, no response is required and action is at the Project Manager's discretion.

A Non Conformance Report (NCR) shall be raised where equipment fails to meet the prescribed PS requirements. For all NCRs, those conducting verification activities shall state the PS requirement and corresponding paragraph that the design does not meet. "Opinions" are not acceptable. If the NCR cannot be resolved during the verification activity, a period shall be agreed for carrying out any necessary repairs or modifications, or for reviewing the PS. Where required, the Project Manager shall implement additional safeguards during this interim period, to compensate for the reduced effectiveness of the affected system.

Changes to the verification schedule, together with the status of the verification activities, shall be summarized in a monthly report to the Project Manager. This shall also summarize all Observations and NCRs and confirm whether they have been closed.

The level of verification on items subject to NCRs shall be reviewed and the verification plan adjusted where required. Responsibility to ensure that the SCEs remain in a suitable condition at all times remains solely with the Project Manager.

A simplified flowchart of the implementation process is provided in Figure 5.1.

Control System alarm settings and shut down set points shall be specified for the relevant Quest CCS Project specific SCEs based on excursion of safe operating envelopes. The alarm settings and shut down set points shall be reported in the Control Narratives for each SCE.

Figure 5.1: TIV Implementation Process