

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF SAFETY AND ENVIRONMENTAL ENFORCEMENT GULF OF MEXICO OCS REGION

NTL No. 2019-G04

Effective Date: May 10, 2019

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF, GULF OF MEXICO OCS REGION

Requesting Approval to Consider External Hydrostatic Pressure Effects When Calculating Internal Pressure Containment Capability for Pressure Containing and Pressure Controlling Subsea Equipment

This Notice to Lessees and Operators (NTL) provides guidance regarding the information that the Bureau of Safety and Environmental Enforcement (BSEE) needs to analyze an operator's alternate equipment request pursuant to 30 CFR 250.141 seeking approval to consider external hydrostatic pressure in the design and calculation of internal pressure containment capability of subsea equipment.

Background

BSEE regulations and the standards incorporated therein by reference require that equipment be designed and rated based on absolute internal pressure alone, with only a few exceptions. For example, the blowout preventer (BOP) system requirements in 30 CFR 250.730 incorporate by reference API Standard 53, ANSI/API Spec. 6A, ANSI/API Spec. 16A, ANSI/API Spec. 16C, API Spec. 16D, and ANSI/API Spec. 17D. *See* 30 CFR 250.730(a)(1), (a)(2), and (c). Each of these documents describes the required equipment in terms of its internal rated working pressure, which is the maximum internal pressure the equipment is designed to contain or control, without consideration of the external hydrostatic pressure to which it is exposed (a.k.a., absolute internal pressure). *See, e.g.*, ANSI/API Spec. 6A, 3.1.89. API RP 2RD, which applies to riser design, is the only standard incorporated by reference that provides for consideration of external hydrostatic pressure in equipment design. *See* 30 CFR 250.292(p)(3), 250.733(b)(2), 250.800(c)(2), 250.901(a)(10) and (d), and 250.1002(b)(5). Operators may want to consider external hydrostatic pressure when designing or selecting other subsea equipment because external pressure in deepwater can significantly reduce the differential pressure acting on the wall of subsea equipment, which effectively increases the equipment's internal pressure containment capability beyond what it would be if only absolute internal pressure was considered.

If an operator would like BSEE to approve the use of alternate equipment based on its internal pressure containment capability considering external hydrostatic pressure instead of its absolute internal pressure, an operator must show that the equipment "provide[s] a level of safety and environmental protection that equals or surpasses current BSEE requirements." *See* 30 CFR 250.141(a). To receive approval, an operator "must describe the site-specific application(s), performance characteristics, and safety features of the proposed procedure or equipment." *See* 30 CFR 250.141(c). To satisfy these standards, the operator must demonstrate that the effects of external hydrostatic pressure will enable safe operation of the equipment in the expected operational environment. This NTL provides guidance regarding the information BSEE needs to make a decision pursuant to 30 CFR 250.141 on whether to approve the use of subsea equipment based on an internal pressure containment capability calculated considering external hydrostatic pressure.

Regulatory Authority

30 CFR § 250.141: “You may use alternate procedures or equipment after receiving approval as described in this section.

- (a) Any alternate procedures or equipment that you propose to use must provide a level of safety and environmental protection that equals or surpasses current BSEE requirements.
- (b) You must receive the District Manager’s or Regional Supervisor’s written approval before you can use alternate procedures or equipment.
- (c) To receive approval, you must either submit information or give an oral presentation to the appropriate Regional Supervisor. Your presentation must describe the site-specific application(s), performance characteristics, and safety features of the proposed procedure or equipment.”

Policy

In 2015, the American Petroleum Institute (API) published API Technical Report 17TR12, “Consideration of External Pressure in the Design and Pressure Rating of Subsea Equipment.” This API document specifically addresses considerations for the use of external hydrostatic pressure effects in calculating internal pressure containment capability for subsea equipment. API Technical Report 17TR12 introduces a new term – depth adjusted working pressure (DAWP) – to facilitate the consideration of external hydrostatic pressure when determining the design and pressure containment capability of subsea equipment. It is BSEE policy that the Bureau will only consider requests (pursuant to 30 CFR 250.141) to use subsea equipment that is originally designed and built by an Original Equipment Manufacturer (OEM) with consideration of the effects of external hydrostatic pressure on the internal pressure containment capabilities. The OEM must address the issues outlined in API Technical Report 17TR12 and this NTL in the design. Because of the complexity of calculating internal pressure containment capability using external hydrostatic pressure, BSEE will not approve re-rating existing equipment.

BSEE considers equipment designed using a DAWP, as well as high pressure high temperature (HPHT) equipment, to be non-conventional technology. Therefore, BSEE expects operators to include information about such equipment in their Conceptual Plan and Deepwater Operations Plan (DWOP). *See* 30 CFR 250.286, 250.287. Operators should refer to applicable HPHT regulations, standards, and guidance for equipment with internal absolute pressure above 15,000 psia.

Guidance

Operators must submit a site-specific alternate equipment request pursuant to 30 CFR 250.141 with their Conceptual Plan or DWOP if they would like BSEE to approve the use of equipment based on its internal pressure containment capability considering external hydrostatic pressure instead of its absolute internal pressure. Operators should complete and submit a risk assessment and failure modes analysis to address scenarios where the differential pressure across the pressure controlling components may exceed the absolute internal pressure rating of the equipment. This is a particular concern for newly built pressure controlling and pressure containing complex geometry equipment that is designed considering external hydrostatic pressure. BSEE will only consider alternate equipment requests where the OEM has already designated the DAWP of the equipment.

Operators should not submit an alternate equipment request seeking to have existing equipment

re-rated with a DAWP above the absolute internal pressure rating of the equipment. Existing equipment may have void spaces and sealing elements that are not exposed to external hydrostatic pressure. BSEE will not approve the use of existing pressure controlling equipment based on its internal pressure containment capability considering external hydrostatic pressure because the differential pressure across the pressure controlling parts of the equipment is completely independent of the external hydrostatic pressure.

Operators may request to use alternate equipment under 30 CFR 250.141 to design or use subsea well equipment, subsea production equipment, or pipeline related infrastructure with internal pressure ratings that consider the effects of external hydrostatic pressure. When considering such a request, BSEE will look to whether the operator followed the guidance in API Technical Report 17TR12. For pipelines, operators should follow NTL 2009-G28 (pipelines), as applicable. For pipeline riser systems, compliance with API RP 2RD (risers) is required by the regulations at 30 CFR 250.292(p)(3), 250.733(b)(2), 250.800(c)(2), 250.901(a)(10) and (d), and 250.1002(b)(5). The BSEE Pipeline Section will review pipeline applications. If an operator intends to submit an alternate equipment request, the operator should consult with the bureau as early as possible in the design process.

Guidance Document Statement

BSEE issues NTLs as guidance documents in accordance with 30 CFR 250.103 to clarify or provide more detail about certain BSEE regulatory requirements and to outline the information you provide in your various submittals. Under that authority, this NTL sets forth guidance and clarification regarding certain regulatory requirements and provides a clear and consistent approach to complying with those requirements.

Paperwork Reduction Act of 1995 Statement

The Office of Management and Budget (OMB) has approved the information collection requirements and assigned OMB Control Numbers 1014-0022, 1014-0024, 1014-0028, 1014-0003, 1014-0011, 1014-0016, 1014-0025, and 1014-0026 for the subparts A, B, G, H, I, J, APDs, and APMs regulations. This NTL does not impose any additional information collection requirements subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.).

Contacts

Please address any questions on the content of this NTL to BSEE Gulf of Mexico Regional Field Operations, Technical Assessment Section by e-mailing Russell.Hoshman@bsee.gov or Otho.Barnes@bsee.gov.

Lars Herbst
Regional Director

Attachments

Appendix 1: Definitions and Acronyms

Appendix 2: Information Submission Guidance for HPHT Equipment Conceptual Plan(s) when Using External Hydrostatic Pressure to Determine a DAWP

Appendix 3: Information Submission Guidance for Independent Third Party and/or Operator Expert Reviewer Reports involving the Use of External Hydrostatic Pressure to Determine a DAWP for HPHT Equipment

Appendix 1: Definitions and Acronyms

The following definitions are provided to help facilitate communication between operators and BSEE. Where the definitions of terms are inconsistent with those in BSEE regulations and documents incorporated therein, the definitions in the BSEE regulations and documents incorporated therein govern.

Definitions

Absolute Pressure (psia): The pressure measured relative to a vacuum in pounds per square inch (psi). Atmospheric pressure is generally considered to be 14.7 psia.

Ambient Pressure: The pressure exerted on an object by the surrounding medium, such as a gas or liquid, in contact with the object.

Component or Part: For the purpose of this document, a component or part is an identifiable portion of a piece of equipment, assembly, or sub-assembly that cannot be dismantled further.

Conceptual Plan: The plan described in the regulations at 30 CFR 250.288 through 250.290, required as part of the DWOP process.

Depth Adjusted Working Pressure at a Specified Water Depth (DAWP (psia) @ SWD (ft.)): The maximum internal pressure a piece of equipment is designed to contain and/or control taking into consideration the external hydrostatic pressure at a specified water depth (measured in psia – absolute pressure). *See* API Technical Report 17TR12.

Differential Pressure (psid): The difference between pressure at two points (P1 in (psia) and P2 in (psia)) expressed in (psid).

Deepwater Operations Plan (DWOP): The plan described in the regulations at 30 CFR 250.286 through 250.295 that provides sufficient information for BSEE to review a proposed deepwater development project and any other project that uses non-conventional production or completion technology.

External Hydrostatic Pressure: The pressure measured at depth in water in (psia) or estimated using External Hydrostatic Pressure in (psia) = 0.052 * (water density in #/gal) * (True Vertical Depth from Sea-level to depth of interest in feet).

Equipment: Any single completed unit that can be used for its intended purpose without further processing or assembly.

Equipment Diagrams: Sketches or diagrams that show the name(s) and location(s) of the components, assemblies, sub-assemblies, and sealing elements contained within the piece of equipment.

Functional Specifications: Project-specific requirements developed by the equipment end-user or operator typically contained in a document that describes the features, characteristics, process conditions, boundaries, and exclusions defining the performance and use requirements of a product,

process, or service.

Gauge Pressure (psig): The absolute internal pressure of a system minus the absolute external ambient pressure. At the surface, gauge pressure is expressed as the absolute pressure in (psia) – 14.7 (psia) = gauge pressure in (psig). Subsea, gauge pressure is expressed as the absolute pressure in (psia) – external hydrostatic pressure in (psia) = subsea gauge pressure in (psig). It should be noted that Gauge Pressure and Differential Pressure can be equal.

High Pressure High Temperature (HPHT) Environment:

As stated in 30 CFR 250.804(b), *HPHT environment* means when one or more of the following well conditions exist:

- (1) The completion of the well requires completion equipment or well control equipment assigned a pressure rating greater than 15,000 psia or a temperature rating greater than 350 °F;
- (2) The maximum anticipated surface pressure or shut-in tubing pressure is greater than 15,000 psia on the seafloor for a well with a subsea wellhead or at the surface for a well with a surface wellhead; or
- (3) The flowing temperature is equal to or greater than 350 °F on the seafloor for a well with a subsea wellhead or at the surface for a well with a surface wellhead.

HPHT Equipment Conceptual Plan (Equipment C Plan): A site specific or non-site specific plan that typically includes the following elements (which may be split between initial and final plans): a list of proposed equipment, components, assemblies, and sub-assemblies and their categorization, a summary of the proposed basis of design, any I3P nomination, any I3P and/or OER review plan, any I3P and/or OER reports and a statement that the HPHT equipment is Fit-For-Service in the applicable HPHT environment. Multiple pieces of equipment, components, assemblies, and sub-assemblies can be combined into one Equipment C Plan. For HPHT wells, operators may submit at the Conceptual Plan stage information required by 30 CFR 250.291, 250.292, 250.732, 250.804, and regulations regarding APDs and APMs to ensure that the well equipment is acceptable early in the process.

Independent Third Party (I3P): Individual or organization that consists of a qualified expert or team of experts that reviews and analyzes the material selection, design verification analysis, and design validation testing performed by either the Original Equipment Manufacturer (OEM) or the operator. The I3P must meet the requirements of 30 CFR 250.732(b).

Operator Expert Reviewer (OER): A recognized expert employed or retained by the operator or a third party employed or retained by the operator who is not acting as the I3P.

Operating Margin: The difference in pressure between the maximum anticipated surface pressure (MASP) for the completion case for completion operations, MASP for the drilling case for drilling operations, Shut-in Tubing Pressure (SITP), or Expected Surface Pressure (ESP) for an intervention operation and the required injection pressure needed at the wellhead for kill weight fluid to be bull headed if necessary.

Pressure Containing: A description of a part exposed to wellbore fluids whose failure to function as intended would result in a release of wellbore fluid to the environment.

Pressure Controlling: A description of a part that controls or regulates the movement of pressurized fluids (Example: Valve-bore sealing mechanisms (ball or gate), choke trim, or BOP rams).

Primary Barrier: First piece of equipment or system that prevents flow from a source as defined in API 17TR8, or an alternate definition proposed by the operator and approved by BSEE.

NOTE: BSEE recognizes that equipment barrier functions may change with the mode of operations. The modes of operations are drilling, completion, production, injection, workover, and abandonment. BSEE created equipment categorization to recognize that during one or more of these modes of operation, a particular piece of equipment may have to function as a primary barrier.

Rated Working Pressure (RWP): The maximum internal pressure a piece of equipment is designed to contain and/or control. RWP is expressed in absolute pressure (psia) without consideration of external pressure.

Secondary Barrier: Piece of equipment or system that prevents flow from a source in the event the primary barrier fails, as defined in API Technical Report 17TR8.

Sealing Element: A component or part of a pressure-containing or pressure-controlling component that prevents leakage at the intersection of two parts or components. A sealing element may be metallic, thermoplastic, or elastomeric.

Subsea Production Equipment: All production equipment from the wing valve on the tree to the Boarding Shut-Down Valve on a production platform. Examples include flowline jumpers, PLETs, PLEMs, umbilicals, manifolds, pipelines, flowlines, risers, and HIPPS systems.

System: For the purpose of this document, a system is two or more pieces of equipment working together to perform an identifiable function.

Technical Specifications: Documented technical requirements for a piece of equipment developed by the OEM to be fulfilled by the product, process, or service, in order to comply with the Functional Specifications developed by the end user or operator of the equipment. Technical Specifications form an equipment's operating envelope. In addition to load capacity, the equipment's Technical Specification should include the Temperature Classification, the Material Class, the Product Specification level (PSL), and the Performance Requirements (PR).

Acronyms

API: American Petroleum Institute

APD: Application for Permit to Drill

APM: Application for Permit to Modify

BOP: Blowout Preventer

BSEE: Bureau of Safety and Environmental Enforcement

CFR: Code of Federal Regulations

C Plan: Conceptual Plan

DAWP: Depth Adjusted Working Pressure

DWOP: Deepwater Operations Plan

ESP: Expected Surface Pressure
HIPPS: High Integrity Pressure Protection System
HPHT: High Pressure High Temperature
I3P: Independent Third Party
OCS: Outer Continental Shelf
OEM: Original Equipment Manufacturer
OER: Operator Expert Reviewer
PLEM: Pipeline End Manifold
PLET: Pipeline End Termination
RWP: Rated Working Pressure
SWD: Specified Water Depth
TR: Technical Report

APPENDIX 2: Information Submission Guidance for HPHT Equipment Conceptual Plan(s) when Using External Hydrostatic Pressure to Determine a DAWP

When submitting a request to use external hydrostatic pressure to determine a DAWP @ SWD for HPHT equipment, operators must follow the guidance provided in this NTL to enable BSEE's consideration of the required alternate equipment approval. Operators must also follow BSEE's HPHT regulations if the absolute internal pressure is greater than 15,000 psia. Operators should also consider the additional guidance documents discussed below.

For HPHT equipment, this NTL should be used in conjunction with NTL 2019-G03– Guidance for Information Submissions Regarding Site Specific and Non-Site Specific HPHT Equipment Design Verification Analysis and Design Validation Testing (HPHT Equipment NTL). Please see the HPHT Equipment NTL for additional guidance where it is noted that guidance in that NTL is applicable. Guidance specific to this NTL is denoted with “(EH).” This NTL references the HPHT Equipment NTL to facilitate information submission supporting a 30 CFR 250.141 request pursuant to this NTL in conjunction with information submission pursuant to the HPHT Equipment NTL. Operators should be aware that BSEE approval of this equipment is a prerequisite for deployment.

Operators Should Consider Submitting the Following Information in a Conceptual Plan:

1. A list of qualifications for an I3P(s) and/or list of all OERs (HPHT Equipment NTL)
2. List of Equipment, Components, Assemblies, and Sub-assemblies shown on an equipment diagram (HPHT Equipment NTL)
3. Equipment Categorization (HPHT Equipment NTL)
4. Summary of the Proposed Basis for the Design (HPHT Equipment NTL and EH)
5. Site Specific Functional Specifications (Requirements) (HPHT Equipment NTL and EH)
 - a. For BSEE's alternate equipment evaluation, the summary of defined loads must consider:
 - i. The Maximum Source Pressure (absolute pressure), Maximum Anticipated Surface Pressure (MASP), Operating Margin, Temperature, Water Depth, Applied Loads, Fluid Exposure, Environment, Pressure Gradients, Operational Load Cases, and any other factors which affect verification and validation documentation for the site specific conditions.
 - ii. MASP calculated at the seafloor for a subsea wellhead or at the platform for a surface wellhead. For equipment that extends from the seafloor to the surface, such as a Completion Workover Riser system, the operator must define the pressures at the seafloor as well as the pressure at the surface.
 - iii. Identification of all the components for which the operator would like to consider external hydrostatic pressure effects when calculating internal pressure containment capability.
 - iv. For well equipment, the minimum pressure used in the design analysis should be MASP plus an operating margin of at least 500 psi above the MASP for the completion case for completion operations, MASP for the drilling case for drilling operations, or Shut-in Tubing Pressure (SITP) or Expected Surface Pressure for an intervention operation. The operator must submit calculations that show 500 psi is adequate for all potential upset conditions including bull heading. In a well control situation, it may become necessary to inject kill weight

- fluids into the well bore or annulus.
- b. Summary of materials' environmental exposure (HPHT Equipment NTL)
 - c. Summary of other important operations considerations, restrictions, or emergency response (HPHT Equipment NTL and EH). For BSEE's alternate equipment evaluation:
 - i. Operators must demonstrate the ability to train their crews on the equipment's limitations and how to determine DAWP for the setting depth.
 - ii. Operators must develop plans to satisfy the requirements for pressure testing at the surface, on the deck, and after landing on the well. The operator must pressure test to the DAWP for 0 feet sea level elevation on the deck before deployment. Operators must include testing recommendations for field pressure testing both at the surface on the deck and after installation subsea.
 - iii. For drilling, completion, and production equipment, the operator must describe the redundant barriers and the pressure which the barriers can contain in the upset condition.
 - iv. Operators must document the intended in-service rating of the equipment, clearly identifying the internal pressure containment capability at the various subsea depths (DAWP).
 - v. Operators must describe how they will permanently stamp or mark the rating on the equipment.
 - vi. Operators must describe how hydrostatic backup was considered in the design, including the maximum upset conditions (e.g. blowdown) that pressure controlling components are designed for.
 - d. Summary of the hazards analysis performed by the operator and/or OEM (HPHT Equipment NTL and EH). For BSEE's alternate equipment evaluation:
 - i. Operators or OEMs must identify pressure containing components, pressure controlling components, primary and secondary barrier systems, and void spaces and sealing elements.
 - ii. Operators or OEMs must identify any component that may not be permanently exposed to external hydrostatic pressure (either from the hydrostatic head of seawater or hydrostatic head from fluid backpressure), such as seals, gaskets, flanges, or internal components.
 - iii. Operators or OEMs must develop operating load cases addressing scenarios where the differential pressure across the pressure controlling components may exceed the rated working pressure of the equipment. This should be addressed in the risk and failure mode analysis as part of the operational considerations.
 - iv. Because this equipment cannot be pressure tested at the surface to DAWP for the proposed deployment depth, the operator must include a testing protocol in the hazards analysis. Operators must identify the failure modes that may result in a greater differential pressure (psid) across the pressure controlling part of the equipment than such part would see in normal operations, or a psid that would exceed the equipment's design rating.
 - v. Operators must address how the absolute and differential pressures will be kept below the OEM's pressure ratings for components/assemblies with pressure controlling parts.
 - e. Name of the Original Equipment Manufacturer (HPHT Equipment NTL)
 - f. Complete or partial technical specifications for each piece of HPHT Equipment, component, assembly, or sub-assembly (HPHT Equipment NTL)
6. Document Control Process (HPHT Equipment NTL)

7. Acronyms (HPHT Equipment NTL)

Appendix 3: Information Submission Guidance for Independent Third Party and/or Operator Expert Reviewer Reports involving Use of External Hydrostatic Pressure to Determine a DAWP for HPHT Equipment

When submitting requests to use external hydrostatic pressure to determine a DAWP @ SWD for HPHT equipment, operators must follow BSEE's HPHT regulations and this NTL. Operators should also consider the additional guidance documents discussed below.

BSEE regulations at 30 CFR 250.732 require completion and submission of verification reports prepared by an I3P for HPHT BOP systems and related equipment. BSEE recommends completion and submission of such reports, or OER reports, for all other HPHT equipment to facilitate its review process for HPHT projects. The following guidance is provided for circumstances where the operator chooses to use an I3P or OER, and where I3P reports are required. The operator may submit the reports in any order. The operator may combine individual reports into a single equipment report.

For HPHT equipment, this NTL should be used in conjunction with NTL 2019-G03 – Guidance for Information Submission Regarding Site Specific and Non-Site Specific HPHT Equipment Design Verification Analysis and Design Validation Testing (HPHT Equipment NTL). Please see the HPHT Equipment NTL for additional guidance where it is noted that guidance in that NTL is applicable. Guidance specific to this NTL is denoted with “(EH).” The guidance in the HPHT Equipment NTL is referenced in this NTL so that the operator can see how to submit information supporting a 30 CFR 250.141 request for BSEE to approve alternate equipment based on its internal pressure containment capability considering external hydrostatic pressure in conjunction other HPHT equipment submissions. Operators should be aware that BSEE approval of this equipment is a prerequisite for deployment.

I3P and/or OER Submits Reports for the Site Specific Project Equipment

1. Report (1A) Basis of Design and Functional Specifications (HPHT Equipment NTL and EH). For BSEE's alternate equipment evaluation:
 - a. The I3P/OER must provide an equipment diagram of all components for which the operator requests to consider external hydrostatic pressure effects in calculating internal pressure containment capability, identifying all void spaces that are not exposed to external hydrostatic pressure.
 - i. The I3P/OER must identify pressure containing components, pressure controlling components, primary and secondary barrier systems, and void spaces.
 - ii. The I3P/OER must identify any component that is not permanently exposed to external hydrostatic pressure (either from the hydrostatic head of seawater or hydrostatic head from fluid backpressure), such as seals, gaskets, flanges, or internal components (parts).
2. Report (1B) Material Selection, Qualification, and Testing (HPHT Equipment NTL)
3. Report (1C) Design Verification Analysis (HPHT Equipment NTL and EH). For BSEE's alternate equipment evaluation:
 - a. The I3P/OER must verify, and provide documentation demonstrating, that the operator/OEM has satisfied all the requirements in API Technical Report 17TR12 or provide a justification for an alternative approach.

- b. The I3P/OER must verify that the operator proposes to use only subsea equipment designed and rated by the OEM utilizing external hydrostatic pressure.
 - c. The I3P/OER must review the operator's/OEM's justification for the use of the principles in API Technical Report 17TR12 for the specific equipment and conditions.
 - d. The I3P/OER must review the operator's/OEM's documented load cases / conditions for each pressure containing and pressure controlling piece of equipment. The analysis of these load cases / conditions must be conducted per API Technical Report 17TR12.
 - e. The I3P/OER must review the operator's/OEM's analysis of sealing elements, especially double sealing elements, per API Technical Report 17TR12.
 - f. The I3P/OER must provide documentation of the valve characteristics, including documentation demonstrating whether the valve is upstream or downstream sealing when tested with wellbore fluid (as opposed to water). The operator must be aware of the results and implications of the results. The operating characteristics of some gate valves can be impacted when used with drilling muds. This impact must be understood and the valve designed accordingly.
4. Report (1D) Design Validation Testing (HPHT Equipment NTL and EH). For BSEE's alternate equipment evaluation:
 - a. The I3P/OER must review the Design Validation Testing, confirming that the equipment design meets the Technical Specifications developed by the OEM. Testing must verify the DAWP at the specified water depth as outlined in API Technical Report 17TR12. Particular attention should be paid to Validation Testing. When validating a design considering external hydrostatic pressure, the I3P/OER must justify when a hyperbaric chamber is required and when an alternate process is acceptable.
 5. Report (1E) Load Monitoring (HPHT Equipment NTL)
 6. Report (1F) Fabrication, Quality Management System, and Inspection and Test Plan (HPHT Equipment NTL)
 7. Report (1G) Final Report that ties Reports 1A through 1F together (HPHT Equipment NTL)