REPUBLIC OF TRINIDAD AND TOBAGO
MINISTRY OF ENERGY AND ENERGY INDUSTRIES

TECHNICAL GUIDANCE DOCUMENT - GD 03

VERIFICATION SCHEME FOR OFFSHORE STRUCTURES

STATUTORY INSTRUMENT

HEALTH, SAFETY AND ENVIRONMENTAL/MEASUREMENT DIVISION

CONTENTS

1.0 INTRODUCTION

This guidance document, GD 03, is a subset of the legal framework governing the approval of energy based facilities with specific emphasis on the structural offshore systems, i.e. steel structural assembly comprising of the substructure and superstructure that supports the production, processing and conveyance of produced hydrocarbon.

The document outlines the Ministry of Energy and Energy Industries (MEEI) requirements for guiding the work to be performed by the Certified Verification Agent (CVA) who shall scrutinize, appraise and validate the structural adequacy of the proposed facility for approval purposes.

2.0 OBJECTIVE

In this aspect of the verification scheme, the CVA will be required to verify the adequacy of the offshore structure to meet its anticipated and forecasted loading demands throughout the intended operating life of the facility.

This is to assure the MEEI that the offshore structure has the required structural strength and ability to withstand the forces or conditions that could result in the collapse, buckling, loss of structural members as a result of fatigue or any form of deformation that could impair the ability of the facility to operate as intended and place resources, revenue earning capability of State, people, property and the environment at risk.

In achieving this objective the CVA shall evaluate the phases in the development of the platform as listed in Section 4.0 of this document, so to ensure that risks are properly identified, evaluated and addressed for resolving concerns associated with structural deficiencies that could compromise the integrity of the facility.

3.0 APPLICABILITY

This guidance document is applicable to offshore facilities in the territorial jurisdiction of Trinidad and Tobago that require some form of structural system to elevate the topside production and/or processing facilities and becomes enforceable once the MEEI rules accordingly.

The content of this guidance document is primarily intended to facilitate the approval of Class “A” type or new built facilities as outlined in GD 02. However, the general

principles established herein can be adapted and applied to the other classes of projects requiring MEEI approval i.e. B to E as stated in GD 02.

The following are examples of offshore infrastructure that will have to conform to this guidance document:

- Single caisson type structures
- Fixed type structures which incorporates the use of a jacket and piles
- Compliant tower
- Etc.

Floating systems such as Tension Leg Platform (TLP), SPAR, SBM and FPSO are excluded and will the subject of another MEEI Guidance Document.

4.0 ENGAGEMENT OF CVA SERVICES

Unless indicated otherwise, the MEEI will have full engagement of CVA services for verifying matters in the following development phases of the facility under review:

- Planning
- Design
- Manufacturing/Procurement
- Fabrication
- Load-out, Tie-down and Transportation
- Installation

The engagement of the CVA services to provide requisite technical assurances in all of the areas listed above shall be guided by the MEEI concerns and requirements as per Verification Programme for GD 03.

5.0 VERIFICATION PLAN

In developing a Verification Plan to address matters required of this verification scheme, the CVA shall be guided by GD 02 which list the components as follows:

i. Elements for Verification Process – Phases or aspects of the project to be verified
ii. Matters to be appraised – Topics, themes or areas that are to be examined based on concerns or known problems.
iii. Verification Activities – Description of assessment methodologies, type of examinations, surveys, monitoring and checks to be performed
iv. Level of involvement – Description of how the CVA will prioritize its resources and time to pursue verification activities as per ranking process in DNV Risk Based Verification Standard
v. Assurance Deliverables – Expected outcomes from verification examinations or activities

Because the verification plan will serve as proof of the efforts made by the State to assess and ensure the "Fit-for-Purpose" acceptably of the facility prior to use, the CVA is reminded that the finalized Verification Plan must be submitted to MEEI for official acknowledgement before any clearance can be given for the CVA to pursue the verification assignment.

Other information to be affixed to a Verification Plan should include but not limited to scheduling program for checks or surveys, sources of information, types of verification methodologies available versus that chosen or preferred, etc.

Generally, the DNV Risk Based Verification Standard should guide the determination of the CVA's level of involvement. Where continuous presence for verification checks or surveys is required at certain critical stages such as witnessing installation of platform, the CVA will be obligated to ensure the presence of adequate verification personnel.

The following table 1A demonstrates an illustrative representation of a possible format and type of data that the MEEI expects in a Verification Plan. Note, the table has deliberately omitted the "level of involvement" due to space constraint.

Table 1A: Illustration of a Verification Plan for a jacket and topside facility

No	Elements of Verification Process	Matters to be appraised	Verification Activities	Assurance Deliverables
1.	Planning	a) Development concepts b) Foundation– Geophysical and Geotechnical characteristics c) Seismic and tectonics attributes of platform location d) Spatial Configuration e) Environmental conditions – meteorological, oceanographic, climatic changes, etc f) Performance history g) Challenges to project h) Etc.	a) Examine soundness of preferred concepts b) Check for geological faults, unstable terrain, subsidence, etc c) Assess normal and extreme physical environmental conditions d) Check for performance related problems with chosen technology that were discovered in other operating regions of the world e) Review of climatic change date and trends f) Etc.	a) Chosen platform type or concept is appropriate and acceptable for use b) Area where platform is to be located is safe and stable c) Foundation on which platform is acceptable d) Lessons learned from use of preferred technology have been communicated to project team e) Project team is fully sensitized to need to address worsening oceanographic and meteorological conditions caused by climate change in the design of the platform f) Solution to address challenges are workable g) Etc.
2.	Design	a) In-place analysis b) Dynamic response modeling c) Load distribution d) Stress distribution and concentration e) Sizing of tubular members and joints f) Height of platform g) Corrosions protection h) Sizing of Piling i) Materials determination and selection j) Etc.	a) Check for compliance with design codes and standards b) Check calculations for determining load distribution and sizing of members c) Check drawings d) Review fatigue analysis e) Check live and dead loading projections f) Review plans for expansion of the facility g) Assess soil boring results for pile drivability k) Review generated specifications for Materials of Construction	a) Facility has been properly designed to conform with best industry practices b) Design is in compliance with governing industry standards c) Facility is capable of satisfying all anticipated loading demands d) Corrosion protection system is adequate e) Materials determined for procurement are acceptable f) Etc.

No	Elements of Verification Process	Matters to be appraised	Verification Activities	Assurance Deliverables
3.	Manufacturing/ Procurement	a) Purchase order requests b) QA/QC at steel mill c) Representative samples of steels and materials supplied d) Quality Control for manufacturing process e) Transportation, material handling and storage f) Etc.	a) Review purchase orders for correct material specifications b) Examine mill certification for steel supplied. c) Examine test results on representative samples of steel produced at mill d) Inspect for dents, defects or damages sustained during transshipment	a) Steel manufacturing process is of a high standard to satisfy project needs b) Materials of Construction satisfies design specification and are acceptable for use c) There is no questionable material in materials purchased d) Etc.
4.	Fabrication	a) Fabrication site b) QA/QC procedures c) Qualification of welder d) Material marking and traceability e) Fabrication and elevation procedures f) Alignments and orientation g) Adjustments and changes to original design	a) Monitor work and check procedures for correct placement, erection, alignment, tolerances, and orientation b) Examine NDT records and reports c) Examine repairs d) Check traceability during integration on each member	a) Facility has been built to AFC plans and all changes has been reviewed and accepted b) All weld defects have been repaired and re-examined for acceptance c) Final structural assembly is acceptable for use
5.	Load-out / Tie-down/ Transportation	a) Tow Barge b) Load-out plan c) Load-out equipment d) Tie down plans e) Tie-down equipment and provisions f) Weather conditions	a) Inspect barge, load-out and tie down equipment b) Monitor tow of platform for vortex induced vibration and movement c) Inspect platform for cracks, damages	a) All equipment for load-out, tie-down and transportation are acceptable for use b) Platform arrived intact and free from any major damage c) Cracks or damages sustained have been identified and appropriately repaired
6.	Installation	a) Lift or launch sequences b) Heavy lift vessel capability c) Lifting appliances d) Setting and leveling of platform e) Piling	a) Review lift and launch procedures b) Assess sea state and weather conditions c) Review repair procedures and monitor	a) Platform properly installed b) Problems encountered were addressed through repairs or appropriate corrective actions

			implementation	

6.0 VERIFICATION SCHEME

Early involvement of CVA is critical for the success of the verification scheme and hence the duty holder shall make every effort to retain the services of a CVA at the earliest possible period.

Once the services of the CVA has been confirmed, the CVA shall be responsible for verifying and documenting whether appropriate methods and procedures are prepared, approved and followed and that proper decisions have been made by the persons in authority. Any new technology or changes to standard industry practices that may be employed will also have to be appropriately analyzed.

In undertaking a verification assignment to evaluate an offshore structural facility "Fitness-for Purpose", the CVA shall be guided by appropriate codes and standards (e.g. API RP2A), which shall be listed in the submitted Verification Reports. Monitoring, checks and surveys in the verification process shall also be guided by the Verification Plan. Any new technology or changes to standard industry practices that may be employed must be appropriately analyzed.

In achieving the end deliverables, the CVA must be prepared to work concurrently with the Ministry, contractors and duty holder in the identification of any discrepancies, deviations, flaws, damages or unacceptable conditions and ensure that the corrective action(s) or measure(s) taken are appropriate and acceptable to guarantee that the facility under evaluation can comply and fulfill its intended purpose in a safe, health conscious and environmentally responsible manner.

Regarding submission of verification reports, the MEEI will allow certain verification reports to be combined for submission purposes but the sequence of evaluation must be strictly adhered to. Combinations permitted include:

- Planning and Design
- Manufacturing/Procurement and Fabrication
- Load-out /Tie-down/Transportation and Installation

In addition to this Guidance Document GD 03, the CVA may also be guided by other pertinent Verification Standards. If reference is made to another Verification Standard other than those that have official recognition from MEEI, then the CVA will have to present the standard to MEEI for formal acceptance.

7.0 VERIFICATION PROGRAMME

In pursuing assessment of matters as per Verification Plan for submission in the verification reports, the CVA shall be guided by the under mentioned concerns and requirements of the MEEI, which should be regarded as the minimum and not necessarily the only foci of interest.

a) Planning Verification

The intent of the planning verification is to ensure that the proposed structural facility, in preference to other alternative concepts, for developing an oil and gas field is workable and capable of meeting the needs of the oil and gas operations.

Matters to be assessed by CVA shall include but not limited to:

(i) Evaluation of preferred technology

In determining the acceptability of a proposed development concepts for the project under review, the CVA shall look at all pertinent Front End Engineering Design (FEED) Studies to assess the preferred and alternative development options available to the duty holder for developing the subject oil and gas field.

(ii) Environmental Design Basis

Given the global evidence of changing oceanographic and meteorological conditions that have been impacting negatively on the oil and gas industry, the MEEI cannot afford to have projects decisions being solely based on conventional historical data. It is imperative that present conditions and anticipated future changed be taken into account when designing a platform.

As a result, the CVA shall verify that the environmental conditions, normal and extreme, during the development and operational phases of the facility are true representations of the conditions expected at the intended site over the life of the facility.

The CVA must ensure that environmental criteria being selected are soundly based, clearly and adequately defined, and specified in a manner from which adequate load determinations can be obtained. The CVA shall specify their source(s) of information used in verifying the validity of the environmental data. A comparative assessment shall be made of historical data and projections of forecasted changes in oceanographic and meteorological data.

On the subject of changing climatic conditions, the CVA shall be guided by credible climate change data sanctioned by the United Nations Inter-Governmental Panel on Climate Change (IPCC) and recognized by MEEI.

The CVA shall ensure that due planning consideration was made in enabling facilities to adapt or cope with future predictions on intensification of extremes in oceanic and atmospheric conditions.

Special consideration shall be given to the influence of extremes on the design phase in relation to the determination of adequate air gap, clustering of equipment, configuration and location of blast and fire barrier walls, etc.

(iii) Subsidence

In recognition of documented cases where extraction of natural resources from subsurface reservoirs have resulted in subsidence of platform locations, the CVA shall conduct appropriate reviews to determine the potential for the occurrence of this type of risk in the field targeted for development.

If the risk of subsistence cannot be discounted, then the CVA will proceed with next step to assess strategies to compensate for possibility of loss of platform elevation or reduction in air gap relative to mean sea level.

(iv) Site suitability

In assessing the suitability of the site for locating a facility, the CVA shall evaluate the site selection analyses used to determine the true physical characteristics of the intended location and any associated concerns, which shall include but not limited to the following:

- Seismic characteristics of zone where platform is to be installed.

- Tectonics characteristics of areas where continental plates meet and converge/diverge, which carry potential risk of breakage at faults resulting in gradual/sudden rise or dip in sea bottom terrain where the platform is to be located.

- Seabed geophysical surveys for scouring, mud flows, sand dunes or other concerns that can change the profile of the surface of the sea bottom where the platform is expected to be installed.

- Hard bottom rock outcrops that may be hidden with sea bottom sedimentation and which could affect the platform's ability to achieve a level settlement at time of installation.

- Wave characteristic of certain areas in maritime waters of Trinidad and Tobago, which can have influential fatigue effects on the in place structure.

- Soil mechanical properties via borings samples to ensure appropriate geo-technical characteristics for support and distribution of structural loads and drivability of piles.

The CVA shall ensure that concerns identified are properly addressed in subsequent phases.

(v) Challenges to project

Every project will have unique challenges that must be addressed when planning for the platform e.g. unavailability of preferred heavy lift barge, eddy currents, etc. Proposed solutions to deal with noted challenges must be evaluated for acceptability.

(vi) Historical review

In evaluating the planning phase the CVA shall conduct a holistic assessment of performance for the preferred type of platform technology to uncover associated problems and experienced as well as lessons learned from a global perspective so as to ensure that the duty holder has been properly apprised of any concerns.

b) Structural Design Verification

Design verification seeks to evaluate calculations, modeling, materials determination, …etc. in order to confirm the acceptability of platform's structural performance capabilities.

The CVA shall verify that the methodologies used in analyses and calculations, are correct, appropriate and follow good engineering practice. Every check or review performed by the CVA should be separate from the original work, not necessarily using a different method unless determined otherwise.

Aspects of the design to be scrutinized shall include but not limited to the design loads and load combinations, stresses (member stress ratios), areas of stress concentration, materials selection and designation, connection joints, corrosion allowances, safety factors, redundancy for alternate load paths and other pertinent parameters of the proposed design. The CVA shall also ensure that critical areas of concern within the structure are identified and addressed by duty holder.

Matters for review and verification in the design shall as per minimum pertain to the following:

(i) Foundation

The purpose of this design evaluation is to ensure that the piling design or means of supporting the platform are acceptable and adequate to sustain the anticipated loading conditions or platform loads.

The assessment of foundation design should review the loads distribution via piles or means of anchoring platform to the sea bottom under the most severe conditions. In this regards the site selection analysis, sea bottom survey and geo-technical interpretation shall be reviewed to determine the most appropriate piling design and depth of penetration.

Assessment of the grouting specification for filing the interstitial space that interconnects the jacket skirt guides and the piles shall also be made.

(ii) Structural strength

The design verification shall ensure that the proposed platform has been designed to withstand the maximum environmental and functional load conditions anticipated during the intended service life at the platform location. The CVA shall ensure that the design evaluation satisfies the initial design criteria in all respects. The CVA shall review the following:-

(1) In place analysis for stress distribution

(2) Extreme storm event response analysis.

(3) Seismic Analysis – Strength and Ductility levels

(4) Fatigue analysis

(5) Corrosion protection analysis

(6) Material Selection analysis

(iii) Modeling/Simulation

The CVA shall ensure that the modeling/simulation used to determine the dynamic performance and capabilities of the platform when in-place took into account all factors, and assumptions at all stages of platform life are soundly based.

(iv) Failure Modes

With the proclamation of the Occupational Health and Safety Act 2004, the MEEI is obligated to evaluate certain modes of failure associated with a platform to ensure that personnel on board have a chance of survival.

In this area of interest, the CVA shall assess and advise accordingly on the acceptability of strategies to ensure survival of personnel on board facility.

Matters for the CVA to follow up on in conducting the verification assessment shall include but not limited to the following:

- Structural deformation and weakening under a major fire event:

  The CVA shall review analysis of major fire on board the platform to ensure that structural member most prone to weakening or deformation from impingement of fire and radiation effects are properly sized or protected via fireproofing to allow sufficient time for structure to maintain its standard upright posture, thus facilitating the escape of platform personnel via survival crafts.

- Push over during extreme events:

  In the event it is not possible to evacuate personnel from a platform upon the approach of an extreme storm event or onset of a rare and intense earthquake, the platform must be equipped with required capabilities to resist pushed over.

  It is imperative that duty holder become aware or sensitized to recognize the symptoms or pending threaten conditions that could result in its failure.

  In acquiring this level of awareness, the CVA shall conduct appropriate Pushover Analysis (ultimate strength analysis) to determine the forces and conditions that could cause a platform to bend or topple over.

  Where the result of such an analysis shows that rules of conventional design standards are inadequate, the CVA shall advise the duty holder accordingly so that appropriate action can be taken to compensate for noted risk.

c) Manufacturing/Procurement Verification

The primary concern for the MEEI in this area related to the quality of steel being supplied from the mill, defects that could introduced in the rolling and seam welding process, loss of metal integrity due to poor preservation of finished sections.

The CVA will be required to assess the quality of steel and materials used for constructing the platform to ensure that they are manufactured to specifications. This as determined necessary by Verification Plan may involve site visit to the steel manufacturing plant to assess quality control.

For projects where tubular sections are pre-rolled in a foreign country, prior to being dispatched to Trinidad, the CVA will be responsible for assessing the rolling, heat treatment, stress relieving and the seam welding processes. Assessment will also be made on how these sections are transshipped and stored to minimize damages.

d) Fabrication Verification

The CVA shall monitor the fabrication of the platform to ensure that it is built in accordance with the approved design plans, specifications and procedures.

The CVA shall ensure that all construction work and integration of equipment onto facility is continuously supervised by competent persons both at the fabrication yard(s) and at the places of manufacture of assemblies and sub-assemblies.

Matters for verifications shall include the vetting or appraisal of the following:-

(1) Changes from Approved for Constructions (AFC) drawings and project details.

(2) Quality Assurance and Quality Control procedures.

(3) Material marking and traceability procedures.

(4) Welder and welding procedure qualification, documentation and identification.

(5) Fabrication and erection procedures, including alignment procedures, to ensure over stressing of members do not occur.

(6) Inspection and Non-destructive testing (NDT) requirements, documentation procedures and evaluation of results.

(7) Destructive testing requirements and results.

(8) Repair procedures.

(9) Audits of fabrication facilities i.e. evaluate aspects of the facilities that could affect the fabrication process e.g. Lightning, ventilation, material handling and storage, utilities, hoisting capabilities, …etc.

(10) Materials of construction quality assurance (ensure conformance to specifications).

(11) Structural tolerances, alignment and dimensional checks.

(12) Installation of corrosion protection systems

(13) Painting of protective layer in splash zone for preventing corrosion and fouling

(14) Document control.

(15) Completion Certificates

The fabrication verification activities will require periodic surveys to the fabrication facilities. The time of these visits shall be in accordance to level of involvement as per Verification Plan so as to best assess the aforementioned activities and provide an accurate measure by which the quality of the fabrication work can be evaluated.

e) Load-out, Tie-down & Transportation Verification

The CVA shall witness the load-out, tie-down and transportation of the various fabricated components to ensure that the jacket, topside and piles do not sustain any damages that may compromise the overall platform integrity.

Matters to be reviewed for the verification purposes includes:

1) Tow barge(s) selection analysis

2) Load-out analysis and procedures

3) Tie-down analysis, materials and procedure

4) Stability analysis

5) Tow analysis and procedures (evaluate appropriateness of tow vessels)

6) Tow Route selection analysis

7) Contingency plans for sheltering during extreme weather

8) Movement of the structure during tow

9) Assessment on repairs to damages sustained after transportation to location.

The CVA must have continuous presence during the tow or transportation of the platform's substructure and superstructure. Any excessive movement such as wobbling, rotation or vibration of the structural assemblies or members under tow must be noted for follow-up investigation.

The CVA shall conduct an on site damage survey after transportation to location. Damages sustained during load-out and transportation shall be reported promptly to the Ministry. These damages must be repaired prior to proceeding with installation.

f) Installation Verification

The CVA shall witness the installation of the platform's substructure and superstructure components to ensure that the platform has been installed at its intended location in accordance with the approved plans, specifications and procedures.

Should there be any deviations from the approved installation plan, the CVA shall determine whether it is within acceptable tolerance limits and shall also ensure that it does not affect the integrity of the platform and its ability to cope with anticipated loading conditions.

Installation verification matters shall include:-

1) Review of lift or launch analyses and procedures.

2) Assessment of capabilities of heavy lift vessels and equipment used in the installation program.

3) Verify suitability of physical Oceanographic/ Meteorological conditions prior to execution of lift or launch sequence.

4) Verify sea bottom profile prior to execution of lift or launch sequence.

5) Monitor installation activities (including jacket lifting, launching and up-righting, jacket leveling and piling installation, deck and appurtenance installation).

6) Assess the placement, meshing together or interconnection of topside and the jacket.

7) Assess installation of riser guard, flare boom, accommodation unit or other packages that came as separate units.

8) Review repair procedures for addressing damages, misalignments or out of level conditions.

9) Assessment of dents and deformation sustained after installation.

10) Review contingency plans.

Installation phase will require CVA to have presence for continuous monitoring. Adequate verification personnel must be available to witness surface activities and subsurface activities simultaneously.

After setting jacket in water, the CVA shall verify that the jacket is in it correct location, submergence depth and orientation. The CVA shall also assess the acceptability of the final leveling position prior to driving of the piles. Any adjustments to stabbing cone to facilitate acceptance of the topside must be assessed and notified promptly to the Ministry.

8.0 QUERIES

Queries on this guidance document can be forwarded to the Office of the Chief Mechanical Engineer, Health, Safety and Environmental/Measurement Division, who has the responsibility for formulating and managing implementation of this guidance document.

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9.0 ENFORCEMENT

Version: GD 03

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This version of the verification scheme supercedes last enforced version and its predecessors and takes legal effect from July 2006, and is applicable to all fixed offshore energy-based establishments under the jurisdiction of the MEEI.

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