REPUBLIC OF TRINIDAD AND TOBAGO
MINISTRY OF ENERGY AND ENERGY INDUSTRIES

TECHNICAL GUIDANCE DOCUMENT- GD 04

VERFICATION SCHEME FOR PIPELINE SYSTEMS

STATUTORY INSTRUMENT

HEALTH, SAFETY AND ENVIRONMENTAL/MEASUREMENT DIVISION

CONTENTS

1.0 INTRODUCTION

This guidance document, GD 04, is a subset of the legal framework governing the approval of energy-based facilities with specific emphasis on the onshore and offshore pipeline systems.

The document outlines 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 proposed pipeline systems for approval purposes.

2.0 OBJECTIVE

In this aspect of the verification scheme, the CVA will be required to verify the structural integrity or adequacy of the pipeline system to cope with its anticipated and forecasted capacity and loading demands throughout its intended operating life.

This is to assure the MEEI that the pipeline system has the required structural strength and ability to withstand the forces or conditions that could result in the loss of containment or production, as well as impair the ability of the facility to operate as intended and place resources, revenue earning capability of the State, people, property and the environment at risk.

In achieving this objective the CVA shall evaluate the phases in the development of the pipeline system as listed in Section 4.0 of this document, with intent on ensuring that risks are properly identified, evaluated and addressed for resolving concerns associated with structural deficiencies that could compromise the integrity of the pipeline systems and associated facilities.

3.0 APPLICABILITY

This guidance document is applicable to all onshore and offshore pipeline systems and associated facilities that intends to operate in the territorial jurisdiction of Trinidad and Tobago 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 Guidance Document GD 02. However, the general principles established herein can be adapted and applied to the other facility classes of projects requiring MEEI approval i.e. B to E as stated in GD 02.

The following are examples of pipeline systems and associated infrastructure, whether laid on surface, buried, directionally drilled, sleeved or encapsulated, that will have to conform to this guidance document:

- Rigid pipeline systems
- Flexible pipeline systems
- Import and export risers
- Blow down and valve stations
- Pig launcher and receiver systems
- Pipeline End Manifolds (PLEM)
- Manifold valve switching systems
- Connection/tie-in points, piggable valves and wyes
- Catchments for liquid drop out

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
- Manufacture/Procurement
- Construction i.e. pre-construction, pipe transfer, integration of pipe segments, installation and Right-of-Way (ROW) rehabilitation
- Commissioning

The engagement of the CVA services to provide the requisite technical assurances in all of the areas listed above shall be guided by the MEEI's concerns and requirements as per Verification Programme for GD 04.

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 witnessing installation of platform, the CVA will be obligated to ensure the presence of adequate verification personnel.

The following table 1B 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 1B: Illustration of a Verification Plan for an offshore rigid pipeline system

No	Elements of Verification Process	Matters to be appraised	Verification Activities	Assurance Deliverables
1.	Planning	a) Development concepts b) Pipeline Route c) Seismic and tectonics attributes in areas where pipeline is laid d) Pipe lay options Environmental conditions – meteorological, oceanographic, climatic changes, etc e) Performance history f) Challenges to project g) Quality of fluid to be transported h) Operational requirements i) 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) Assess studies for determining method of laying of pipeline e) Examine the physical and chemical characteristics of fluid expected to flow in pipeline f) Asses challenges to project g) Etc.	a) Chosen concept for pipeline system is appropriate and acceptable for use b) Route where the pipeline is to be located is safe c) Soil or sea bottom in which platform will live is acceptable d) Project team is aware of lessons learned from former pipeline projects e) Project team is fully sensitized to need to address worsening oceanographic and meteorological conditions caused by climate change in the design of the pipeline f) Solution to address challenges are workable g) Etc.
2.	Design	a) Design basis b) Free span c) Expansion d) Hydrostatic collapse e) Crossing of foreign pipeline f) Pipeline installation g) Upheaval and lateral buckling h) Pigging and maintenance i) Spool j) Internal corrosion k) External corrosion l) Erosion m) Fatigue n) On-bottom stability o) Pressure containment j) Hydraulics simulations k) Hydrate/wax formation	a) Check for compliance with design codes and standards b) Check calculations and analyses for determining final wall thickness of pipeline c) Check drawings d) Check design of buckle arrestor e) Review analysis for determining corrosion protection system f) Evaluate design of pipe areas most prone to corrosions g) Assess flow assurances report on steady and transients states – slugging, slack	a) Pipeline 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) All materials selected for procurement and fabrication is acceptable for use f) Etc.

		l) Route survey plans	flow, 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 or steel and materials supplied d) Quality Control for manufacturing process e) Transportation, material handling and storage f) Rolling and forming process g) Etc.	a) Review generated specifications for Materials of Construction b) Review purchase orders for correct material specifications c) Examine mill certification for steel supplied. d) Examine test results on representative samples of steel produced at mill e) 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 impurities in materials purchased d) Diameters of rolled pipe sections are within specialized tolerances e) Etc.
4.	Construction	a) Alignments sheets b) Welder's qualifications c) Automatic welding machine d) NDT procedures e) Material marking and traceability f) Construction procedures g) Adjustments and changes to original design h) Pipelay barge i) QA/QC for pipe integration j) Weather conditions k) Pipe transfer l) Deformation tracing pig	a) Monitor installation to ensure pipeline is not overstressed and installed as per approved plan b) Examine NDT records and reports c) Examine repairs d) Check traceability during integration on each member e) Appraise barge capabilities f) Inspect pipeline for damaged or welding defects	a) Pipeline has been built to satisfy the key aspects of AFC plans and adjustment or changes has been reviewed and accepted b) All defective connection welds have been repaired and re-examined for acceptance c) Final integrated pipeline system is acceptable for use d) Detected deformations, buckles or damages due to installation problems have been repaired to satisfaction
5.	Commissioning	a) Caliper ID gauging pig b) Cleaning and preparation c) Hydrotesting d) Dewatering and drying e) Golden weld f) Repair to leaking	a) Review hydrotest procedures b) Witness hydrotest and validate charts c) Review repair procedures and monitor implementation d) Assess pipeline	a) Pipeline has required pressure containment capacity b) Problems encountered were appropriately addressed through repairs and corrective actions c) Doors and valving on pig launcher and receiver

		area(s) g) First Gas	performance after first gas	have no leak d) Pipeline has satisfied performance expectations

6.0 VERIFICATION SCHEME

Early involvement of CVA is critical to 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 the "Fitness-for Purpose" of a pipeline inclusive of its features and provisions, the CVA shall confirm the boundaries of the verification assignment with MEEI prior to executing required duties and shall be guided by appropriate codes and standards.

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
- Construction
- Commissioning

In addition to this Guidance Document GD 04, 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 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.

Is should be noted that the guidance provided herein is generic and applicable to marine and land-based pipelines whether it is directionally drilled, trenched, buried or surface elevated pipelines. If a specific topic for verification in not applicable, then the CVA should note accordingly and indicate in their reports.

a) Planning Verification

The intent of the planning verification is to ensure that the desired pipeline system, in preference to alternative concepts, for conveyance of hydrocarbon fluids is workable and capable of meeting the needs of the duty holder.

Planning is a critical stage in the development process of a facility that influences all other phases of the project. Oversights or failure to get this phase correct means that deficiencies could be carried up until the last phase or point of detection, after which decisions would have to be made to rectify the problem, which may be costly, or opt to leave alone and learn to adapt.

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

i. Evaluation of preferred technology:

In determining the acceptability of the preferred type of pipeline facility, 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 oil and gas field of interest.

ii. Environmental Design Basis

The CVA shall verify that the anticipated physical environmental conditions, normal and extreme, that could scour away base support or expose the pipeline for subjection to external elements or damaging forces, are a true representation of the conditions anticipated along the intended route.

The CVA shall specify their source(s) of data for cross-referencing information used in verifying the validity of the environmental 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 to protect the pipeline from future predictions on intensification of extremes in oceanic and atmospheric conditions, especially in shore approaches, near shore, flood prone and hilly terrain areas.

iii. Route suitability

The CVA shall review the route selection analysis which can include but not limited to surveys, investigations and geo-technical interpretation.

The assessment of the route on which the pipeline will be laid, buried or be pulled through after being HDD should be crosschecked for concerns (e.g. presence of hard material in HDD bore) that could damage the pipeline and be a source of localized failure.

CVA shall liaise with MEEI's Pipeline Licensing Section of MEEI, Land and Survey Division, Town and Country Planning Division to get concurrence on the route and information on other possible use for the route of interest.

iv. Challenges to project

Every project will have unique challenges that must be addressed when planning for the platform e.g. uneven sea bottom, coral, hydrocarbon seepage, buoyancy problems in marsh lands, foreign metals robbing pipeline of corrosion protection, etc. Proposed solutions to deal with challenges must be evaluated for acceptability.

v. Historical review

In evaluating the planning phase the CVA shall conduct a holistic assessment of performance for the preferred type of pipeline 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) Design Verification

In ensuring that the design premises are acceptable, the CVA shall review the following which includes but is not limited to:-

i) Stress analysis

ii) Fatigue analysis

iii) Corrosion analysis

iv) Material Selection analysis

v) Failure Modes

The CVA shall ensure that the designers took into account all pertinent factors in designing the pipeline, and that assumptions at the different life cycle stages are soundly based. The CVA shall also verify that the methodology used, in the analyses and calculations, are correct, appropriate and follow good engineering practice.

Aspects of the design to be scrutinized shall include the internal (e.g. pressure) and external loads (e.g. pulling through directional bore), stressed areas such as bends, suitability of pipe materials selected for class designations, ability to achieve desired welds, corrosion allowances, safety factors and other parameters as deemed pertinent by CVA.

The CVA shall also ensure that critical 'areas of concern' identified in the design are highlighted and dealt with accordingly.

Matters requiring special emphasis:

i. Pressure containment capacity:

- The design verification shall ensure that the proposed pipeline has been designed to withstand the maximum internal static and dynamic pressure loading conditions anticipated during the intended service life.

- The CVA shall use the "push-over concept" to assess the extreme conditions that can be tolerated, higher than maximum allowable operating pressures (MAOP), that would cause the pipeline to burst.

  The CVA shall ensure that the duty holders are fully sensitized of the symptoms that indicate pending threatening condition.

- Transient hammer effect due to rapid valve closure or slugging shall also be assessed.

ii. Pipeline Hydraulics

The CVA shall evaluate the various flow regimes anticipated in the pipeline to assess steady and transient states and resulting effects such as slugging, back pressure, vibration, flow inducted corrosion at bends or other areas of interest, etc.

iii. Pipe collapse:

- In cases of submerged pipelines, the strength of the pipeline in vacuum condition to withstand collapse under hydrostatic head of surrounding water should be evaluated.

- Pipeline that traverses over hilly terrain shall be evaluated for "slack flow" or vacuum condition created when there is insufficient back pressure that causes the liquid in pipeline to part.

iv. Pipe Support Infrastructure

- In cases of elevated or suspended pipeline such as crossing over rivers, wide free spans or valleys, etc., the CVA will conduct appropriate structural analyses to determine the adequacy of the pipe support infrastructure.

v. Valve stations

- The behaviour of pipeline under various failure modes can cause the pipeline to move under the reactive forces of the escaping pressurized fluid.

  The CVA shall examine locations most prone to failure and simulations to ensure that isolation valve stations are not located at these areas.

- The CVA shall ensure that check valves installed at these stations are of the piggable type that facilitates intelligent surveillance pigs.

c) Manufacture/Procurement Verification

The CVA shall appraise the metallurgic properties and characteristics of the sourced pipe material to ensure that it conforms to the design specifications.

Steel mills manufacturing the pipeline shall be assessed to ensure that the quality of pipeline desired is actually what is being delivered by the mill. Pipeline materials that have slight but questionable deviations in tolerances for material specifications and dimensions shall be assessed to determine acceptability.

The methods of transshipment, offloading, conveyance to temporary holding sites or pipe handling vessel shall be appraised to ensure that damages do not occur to the pipe sections. Any structurally damaged pipe sections shall be tagged by CVA and noted in the Verification Report.

Any intended use of pipe joints with minimal damages or dents that may be still acceptable for use shall be assessed and documented for tracking purposes.

If pipe sections or joints are to be coated with internal coating for flow enhancement and/or corrosion protection, then the CVA should assess the quality of work undertaken.

Concrete coating should also be assessed to determine compliance with specifications.

d) Construction Verification

Construction in this section shall be interpreted as pre-construction site preparation, preparation of pipe joints, welding together or integration of pipe joints, QA/QC activities, installation along selected route, replacement of covering material and connection to export/receiving facility or tie-in to other pipelines.

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

The construction verification activities will include but is not limited to the following:

(1) Quality assurance and quality control procedures.

(2) Material markings and traceability procedures.

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

(4) Cold bending, joining, alignment and erection procedures and works to ensure stressing of pipeline beyond desired limits do not occur.

(5) Inspection and Non-destructive Testing (NDT) requirements, documentation procedures and evaluation of results. Evaluation on competence of persons performing inspections and NDT is also required.

(6) Assessing destructive testing requirements and results on weld samples.

(7) Installation of pipeline in trench or seabed.

(8) HAZID study for pipeline project

(9) Repair procedures.

(10) Equipment, machinery and facilities used in the construction activity e.g. screening against rain and moisture, etc.

(11) Tolerances, alignment and dimensional checks.

(12) Corrosion protection systems

(13) Document control and record keeping

(14) Suitability of covering fill material in direct contact with pipe

(15) Post lay video in marine areas.

The CVA shall ensure that competent persons continuously monitor and witness all construction work as per Verification Plan commitments. The construction verification activities will require periodic surveys to the construction site or vessel. If problems arise during construction of pipeline and the CVA has to adjust the schedule of monitoring activities from that stated in Verification Plan, to provide a better assessment on the quality of the construction work, then due representation should be made for the requested adjustment.

With respect to directional-drilled pipeline, the CVA shall verify that the pulling process to pass the pipeline through the bore and ensure that damages are not sustained to the pipeline and its coatings. Methods employed for the verification process shall be clearly stated.

Following installation of onshore pipeline the CVA shall ensure that any imported filling material selected are of a suitable specification and the ROW rehabilitation works are properly executed.

With regards to land on onshore pipeline that passes through undulating terrain, the CVA shall note all suspected points of slope and side slope instability and ensure that the duty holder take appropriate action to stabilize the pipeline.

e) Commissioning Verification

The CVA shall review the commissioning program to ensure that it can satisfy class requirements of respective ASME Pipeline Engineering Codes.

The CVA shall witness the commissioning hydrotest and review the results of the test charts to ensure that the pipeline has met the acceptance criteria.

Should there be any deviations or suspected leaks within the pipeline system, then the CVA shall be responsible for evaluating the cause and notifying the MEEI accordingly.

If the cause is a localized issue such as a flange leak that is not related to the actual pipeline system, then the CVA shall note actions taken by the commissioning team to rectify the situation for reconvening the test.

If the cause is attributed to the actual pipeline, then the CVA shall appraise repair procedures and methodologies to be employed and advise the Ministry on sanctioning the execution of repairs.

If the cause is attributed to the actual pipeline and is a significant issue for concern then the CVA shall notify the Ministry and place itself on a full time mode to assess repairs.

Other commissioning verification matters shall include but is not limited to: -

1) Assessment of equipment used in the commissioning program. Checks on certification records for determining whether gauges for sensing test parameters are acceptable.

2) Review of repair procedures, technology and methodology.

3) Monitor dewatering and drying of pipeline

4) Check caliper or gauging pig to ensure no deformation

5) Review of plans and provisions for crossing new built pipeline without causing damages.

6) Review post installation repairs e.g. adding sand bags to minimize free span, etc.

In facilitating the introduction of first gas via provisional approval from MEEI, the CVA shall advise the MEEI of any unacceptable conditions.

Following the introduction of first gas, the CVA shall witness the performance of the pipeline system to be reassured it is performing as intended. The period to witness this activity will be determined by Verification Plan after which the final verification report can be issued.

8.0 TERMS AND DEFINITIONS

a) "Approval" refers to an official authorization granted by MEEI that confirms acceptability of an energy-based facility for conducting operational activities in the territorial jurisdiction of Trinidad and Tobago.

b) "Facility" or "Energy-based Facility" refers to any infrastructure whether individual or collective assemblage of systems and components used in the production, transportation, processing, storage, and marketing of hydrocarbons resources and its derivatives e.g. fixed offshore platform, refinery or petrochemical plant, sub-sea pipeline, floating production storage and offloading, etc.

c) "Fit-for-Purpose" shall relate to verifying that all related hardware and software systems and components that constitute the facility were properly designed, built, integrated together and tested for acceptance to ensure that the final facility is capable of delivering the required performance expectations.

d) "Operational Preparedness" shall relate to verifying that the status of the elements of the management system for facilitating proper human interface and control of the facility.

e) "Features" shall relate to aspects of the facility that form an integral part or influence in the process stream e.g. ESD, pig launcher and receiver, depressurization and relief, gas detection, etc.

f) "Provisions" shall relate to aspects of the facility that are necessary for supporting loss prevention and control, and operational activities but do not directly influence the integrity or operability of the facility's process stream e.g. pedestal cranes, fire tenders, setback distances, escape routes, safe refuge areas, explosion barriers etc.

g) "Integrity" shall relate to the ability of an engineered system to resist failure by having the required mechanical, civil and electrical performance characteristics to cope with anticipated opposing forces, transients or performance compromising situations or conditions.

9.0 REFERENCES

Recognized verification standards that support this verification scheme are:

1) Det Norske Veritas (DNV) Offshore Service Specification: DNV-OSS-300, Risk Based Verfication

2) Det Norske Veritas (DNV) Offshore Standard: DNV-OSS-301, Certification and Verification of Pipelines, October 2000

10.0 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.

Mail: Ministry of Energy and Energy Industries
Health, Safety and Environmental/ Measurement Division
70-76 Pointe-a-Pierre Rd
San Fernando

Trinidad

Email: iramdahin@energy.gov.tt

Tel: (868) 652-3126/2075/3070 Ext: 253

Fax: (868) 652-3129

11.0 ENFORCEMENT

Version: GD 04

Dated: July 2006

This version of the verification scheme supersedes last enforced version and takes legal effect from July 2006, and is applicable to all onshore and offshore pipeline systems that falls under the jurisdiction of the MEEI.

Prepared by : Ian Ramdahin

Chief Mechanical Engineer

Reviewed by: Tensing Ramlakhan

Director, Operations

Sanctioned by: David Small

Director, Policy and Planning