Northeast Gas Association

Guideline for Gas System Engineering Design Review

Foreword

This Guideline was developed by members of the Northeast Gas Association (NGA) and is intended to provide NGA Pipeline Operators with a framework and considerations for developing and enhancing an organization-specific gas system engineering design review (EDR) process. The goal of implementing a gas system design review process is to ensure that gas transmission and distribution systems are designed, constructed and operated in a safe and reliable manner with the goal of zero incidents. Engineering design reviews as applied to natural gas system assets and operations can range from:

- Standard designs, application of standard designs, or simple changes to standard designs, to;
- Complex, non-standard designs that include many linked stakeholders and subject matter experts (SME's) within an organization.

Regardless of design complexity, organization size or scale of assets being managed, each organization should have a design review process in place that ensures appropriate review of essential elements of design with a focus on pipeline and process safety, constructability and operability. The design, as well as the design review, must be conducted by competent person(s) familiar with the specific subject matter commensurate with the complexity of the project. The scope of this document includes gas transmission and distribution pipelines, systems and appurtenances.

The Northeast Gas Association (NGA) is a regional trade association that focuses on education and training, technology research and development, operations, planning and increasing public awareness of natural gas including natural gas pipeline safety within the Northeast region of the U.S. The Northeast Gas Association represents gas distribution companies, transmission companies, liquefied and compressed natural gas suppliers and associate member companies. NGA member companies provide natural gas service to over 13 million customers in 9 states (CT, MA, ME, NH, NJ, NY, PA, RI, VT).

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Central Hudson Gas & Electric Corp.

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Summit Natural Gas of Maine

UGI Utilities, Inc

Unitil Gas & Electric Light Company

Vermont Gas Systems Inc.

Guideline for Gas System Engineering Design Review

APPENDIX

1. Purpose:

The Northeast Gas Association provides this Engineering Design Review (EDR) Guideline to help operators enhance risk management practices and safety assurance through a strategy of added layers of protection and *defense in depth* throughout the design, construction and inspection review process. The process considerations provided in this document are intended to guide operators in how to determine which parties need to be included in EDR and ensure decisions are vetted appropriately. This process will provide added visibility to the accountability of all individuals involved. Documentation of the steps undertaken through the process will enable transparency. Inclusiveness of all parties who can contribute knowledge and competence results in a broader multidisciplinary and well-rounded perspective on actions that need to be taken. Providing a record of approval by a company specific level of authority, commensurate with the complexity of design, is an added level of assurance that leadership attests to the completeness of the steps undertaken as identified by the operators' written procedures.

EDR, as applied to natural gas system construction (including pipeline abandonment) and operations, is an evaluation process that is a fundamental component of risk management. In some cases, the process is independent of the original design engineer, in which a competent person(s) assesses a project design for conformance with relevant local, state and federal construction codes and permit requirements, pipeline safety regulations, and an operator's specific policies relative to Pipeline Safety Management System (PSMS) requirements, operation and maintenance procedures, construction practices and standard drawings. In addition, the review process may include assessing conformance with the recommended application of specific materials of construction, device(s) and recommended installation practices or requirements by material, equipment and device manufacturers. The design review process also considers and evaluates risks in the process, and specifically, steps to reduce risk by the materials specified, construction and abandonment techniques as well as operational requirements such as management of pressure.

An EDR process also includes elements of constructability and operability where appropriate, depending on complexity. For example, the design review will evaluate the construction methods selected and ensure they are appropriate for the location where the work is to be conducted. Factors such as proximity to other utility infrastructure, surface conditions (e.g. roads, pavement, streams, trees, wetlands, etc.), in the path of mains and service installations, traffic control, and terrain are considered. The EDR will also integrate elements of final as-built construction inspection checklists, pre-startup safety reviews (PSSR) and System Operating Procedures (SOPs). This includes assessing the need for obtaining operational clearance (permission to work) from gas control prior to energizing or deenergizing a pipeline segment. Assessing and implementing these "safety gates" associated with the commissioning and/or decommissioning of facilities associated with the project design implementation are an integral component of the end-to-end safety-in-design review process.

This Guideline provides EDR considerations and guidance for NGA membership associated with development of organization specific EDR process procedures. The scope of this document includes qualification and competency considerations of individuals conducting EDRs, defining essential elements of the EDR process, management of change, continuous improvement, documentation practices and PSSR, as an integral component of design review and constructability/operability considerations.

The Guideline also includes sample Design, Construction and PSSR checklists for pipeline operators to consider when developing organization specific gas system EDR process procedures and checklists.

This Guideline incorporates essential elements and concepts, where applicable, included in Pipeline Safety Management Systems API RP 1173. Some of these core elements include:

- Risk Management;
- Leadership and Management Commitment;
- Safety Assurance;
- Stakeholder Engagement;
- Operational Controls;
- Competency, Awareness and Training;
- Management Review and Continuous Improvement;
- Documentation and Recordkeeping;
- Incident Investigations, Evaluations and Lessons Learned.

In summary, this Guideline is intended to provide a consistent framework and essential elements of the design review process for pipeline operators to consider in developing their organization specific gas EDR process. While essential principles of EDR are applicable to all pipeline operators, large to small; this Guideline is intended to be flexible and scalable depending on the complexity and size of an operator's assets. This Guideline is not intended to supersede local, state or federal license requirements for conducting EDRs.

2. Leadership/Management Commitment and Stakeholder Engagement

Leadership within the operator's organization must make a clear commitment to ensuring appropriate layers of protection are in place within the gas EDR process and establish a monitoring plan. It is important to explain that to take safety performance to the next level, the organization needs to be inclusive of parties which need to be involved in the process, either because they are affected by the work or have knowledge and experience to contribute in identifying and managing design risk factors. This commitment also includes:

- Strengthening the process and improving information flow from front line staff who can identify potential problem areas;
- Encouraging the involvement of employees regardless of position to make recommendations and contribute to decisions;
- Placing a priority on how to get all employees thinking about consequence issues and institutionalizing improvements for consistent application;
- Assuring that in the management review process there are appropriate levels of cross check redundancy in the layers of protection and that interfaces are occurring between departments who need to exchange information;
- Assuring that Management of Change (MOC) is in place and evaluated. Determine if events are monitored, if lessons learned are identified, and corrective actions are taken;
- Committing to establish an audit plan for the gas EDR process on a priority basis.

3. Essential Elements of Gas Engineering Design Review

3.1 The Gas Engineering Design Review Process

Gas EDR is an objective evaluation process that in some cases is independent of the original design engineer/engineering team, in which a competent person(s) assesses core elements of a gas system engineering design (piping systems, gas pressure/flow control facilities, gas processing systems and other facilities and equipment). An engineering design review should be considered a continuous process beginning with the design engineer, internal/external design approvals, construction and final inspection and commissioning of the facility. Knowing someone else in the process will check design work is no excuse for not self- checking each step. The scope and extent of the review process is dependent on the complexity of the procedure, design, construction project or proposed change to an approved procedure, design or project.

For purposes of this document, competent person(s) is defined as a person(s) having appropriate levels of education commensurate with the complexity of the project and/or having demonstrated practical field experience (such as with engineering construction, operational, and regulatory knowledge of the specific subject matter being designed or reviewed). In addition, a competent person would have knowledge of specific and relevant gas system assets to ensure that the application of the design in practical terms does not result in unintended operational consequences that affect safety or reliability of the system. A competent person(s) may be individual(s) within the organization or a designated third party independent of the project.

For distribution system operations, the EDR process typically falls within three sub-processes: Standards, Procedures and Work Practices (including operational enhancements to existing systems, procedures or designs); Standard Designs for Site Specific Projects; and Site/ Project Specific Complex, Non-Standard Designs.

1. Standards, Procedures and Work Practices play an important role in gas system design and operations. These design standards enable consistency in design, construction, operations and maintenance and help ensure compliance and pipeline safety. The EDR process for Standards, Procedures and Work Practices includes a structured approach to review by individuals directly accountable for performing work in accordance with these documents. This would be followed by Standards & Procedures Supervisor/Manager/Technical Expert approval and in some cases, approval by the Chief Engineer, Engineering Director and/or Operations Director. In some organizations, standard construction designs/drawings are incorporated into these documents and follow an integrated design, policy, procedure approval like that described below for Standard Designs. In other cases, "enabling" construction procedures or operating procedures that must be carried out as part of construction, (i.e. purging, tie-in's, etc.) are incorporated into the project specific design review process. A sample review and approval process flow for work methods, procedures, standards & policies is included in Appendix 1.

2. Application of Standard Designs to Site Specific Projects incorporate approved construction standards, specifications, drawings and/or procedures that have gone through a prior EDR process in accordance with an operator's specific policies such as simple mains and services design. These designs typically have a "review gate" process with two to three layers of review starting with the design engineer and associated project SME's (from other related functional areas of the organization such as operations, construction, regulatory, safety, etc.), coupled with a final review by an Engineering Supervisor/Manager, and, in some unique/select cases, for more complex standard project designs, the Engineering Director/Executive. A sample process flow is included in Appendix 2.

As an example, standard project designs include:

- Simple main installation, renewal, replacement, abandonment;
- Simple service installation, renewal, replacement, abandonment;
- Non-complex new valve installation or replacement (not requiring a by-pass); or
- Simple customer meter/regulator installation or replacement.

3. Site/Project Specific, Complex, Non-standard Designs include complex designs or modifications to standard designs *that are not addressed in an operator's specific standard designs, operating procedures, and/or standard construction drawings.* The EDR process for complex, non-standard designs may include an additional review gate by a competent person, independent of the original design team. While most reviews can be effectively conducted by appropriate internal competent personnel, in some specific cases, complex, non-standard EDRs may warrant review by an independent, competent third party. A third party may include a Licensed Professional Engineer (PE) or equivalent Technical Expert with gas engineering design and operating experience commensurate with the complexity of the project.

As an example, non-standard complex EDRs may include:

- Design and construction of new or reconfigured district pressure regulator or custody transfer facility including pressure/flow control and safety monitoring systems beyond the scope of a simple, pressure control standard design;
- Pipeline construction and maintenance activity in the vicinity of a pressure regulator station as defined by an organization's policy or procedure;
- Uprating of intrastate transmission or distribution pipelines outside of the scope of routine uprate projects defined in an organization's standard policy or procedure;
- Gas transmission and/or distribution complex construction/abandonment such as projects incorporating multiple standard design options which in aggregate result in a potential high-risk complex project;
- Design and construction of compressor stations and gas processing facilities.

A sample process flow is included in Appendix 3.

3.2 Core Principles of Design Review

Personnel responsible for design-construction may include appropriate engineering and operations departments, engineering professionals (PE or equivalent technical experts), consultants and contractors. Participants in the design-construction process have individual responsibilities and obligations that are in many cases integrated and interrelated commensurate with the scope and complexity of the design. Regardless of complexity, design review begins with the project design engineer as each designer is responsible for his/her own work. The desired outcome of the EDR process is to ensure any design affecting the gas system minimizes system operational risk while maximizing public safety value. To achieve this goal, EDR must be carried out using an operator approved process that's inclusive of all appropriate stakeholders. Stakeholders are those individuals that may be affected by the work incorporated within an individual design or who have knowledge or experience to contribute which might not be otherwise included.

An operator's specific EDR process policy should be fit-for-purpose relative to project complexity and consider the following elements[3]:

[1] Internal competent personnel may include a Professional Engineer with gas system design experience or an equivalent Technical Expert with experience, commensurate with the complexity and scope of work.

[2] Third party PE must be experienced in gas EDR commensurate with the complexity of the project.
[3] Incorporated from Design Review Principle and Practice, 2013, The Design Council, Royal Institute of British Architects

1. **Independent (Complex, Non-Standard Designs)** – where specified in an operator’s specific policy, is conducted by an individual(s) not directly involved with the project and ensures no conflicts of interest. If specified in an operator’s policy, the independent party performing the EDR may be an employee or a third-party firm.

2. **Expert** – It is carried out by suitably trained individual(s) who is experienced in gas system design and operations. The individual(s) must possess the ability to comment constructively from the standpoints of constructability, operations, pressure control and work site safety.

3. **Objective** – the review focuses on core engineering principles, conformance with the operator’s specific standards and procedures, local, state and federal codes and industry standards.

4. **Multidisciplinary** – It combines perspectives from subject matter experts (SMEs) who are either affected by the work or have knowledge to contribute to provide a complete, well rounded assessment. SME participation may include gas engineering/piping design, gas control, pressure regulation and control, gas construction, regulatory and permitting, procedures and risk assessment specialists.

5. **Accountable** – EDR begins with the design engineer(s) and associated multidisciplinary SME reviews. In practical terms, EDR is a continuous process; it continues throughout the construction and final inspection process to ensure accountability for “as-built” status and that commissioning / decommissioning is in accordance with design requirements. Sign off by the delegated position(s) of authority attests to completion of the steps identified in the procedures. Continuous management review; checks for indicators and metrics as identified in the Management Review discussion below. Reviewing accountability on a continuous basis will reduce risk in the EDR process.

6. **Layered & Transparent** – the EDR process must be transparent, establishing review requirements for standard, non-standard designs and management of change in well-defined policies and procedures. The process by definition must include a “layered” approach where predefined approval checkpoints, or approval “review gates,” are used to ensure operability and constructability throughout the process.

7. **Proportionate –** the review process must be fit-for-purpose and scalable depending on the project. At a minimum, the review process should consider items identified in the checklists included in Appendix 6.

8. **Timely** – pre-defined design review gates and feedback loops should be considered for complex, non-standard designs to ensure efficient response to any required changes.

9. **Advisory –** the EDR process should be advisory and inform the designer/design team; the reviewer does not unilaterally make design change decisions but rather advises the design team and provides impartial advice.

10. **Understandability/Accessibility –** findings and advice are clearly expressed in terms that the design engineer or design team can clearly understand.

3.3 Typical Roles & Responsibilities

While an operator may have different titles for the roles described below, to be effective the EDR process must include a layered approach reviewed by appropriately trained and experienced individuals with subject matter experience. The layered approach that leads to final approval is typically preceded by interim design review gates. SME's collaborate and review the design at designated points in the design process to ensure technical conformance, constructability, and operability. The design review gate approval approach to gas EDR provides layers of protection to identify design anomalies that may impact pipeline safety, operational reliability and efficiency of operations. The concept is consistent with the Plan-Do-Check-Act (PDCA) philosophy incorporated in API RP 1173.

The EDR process starts with the design engineer and ends with final approval by a specified position of authority as defined by the operator. The process includes execution of the roles defined below and the defense-in-depth of multiple disciplines interacting to provide many perspectives. The process is robust through the necessary inclusion of stakeholders who could be affected by the work and have knowledge and competence to contribute to the assessment process. Below are examples of descriptions/positions of authority and the roles they may play in an operator’s EDR process:

- **Engineering Executive** – the Executive sets the tone for the larger organization, procures necessary resources, and manages people, projects, programs and budgets in the engineering organization. The Executive may or may not be directly involved in the approval process for designs. The Executive should require comprehensive EDR with approval processes is being followed by competent people. The Executive must ensure a comprehensive engineer training program is established and continuously updated. The Executive should emphasize and encourage a questioning attitude, collaboration, robust management of change and documentation. The Engineering Executive typically has 6-8 years of progressive responsibility and leadership in gas operations management, engineering or construction;

- **Chief Engineer/Engineering Director** – this position has authority for all final engineering reviews and sign offs for all design types (standard, complex non-standard, etc.) and in some cases, directly reviews more complex high-risk designs. The scope of this role may include; final review of policies associated with design, approvals, management of change, process safety and pre-startup review policies. This position is typically held by an engineering Director or Executive within the organization and is a Licensed PE with appropriate gas engineering design, construction and operational experience (typically a minimum 5 years practical experience) or in lieu of a PE, an engineer in an appropriate discipline with more extensive construction and operational experience (typically greater than 8 years practical experience);

- **Technical Expert/Professional Engineer (PE) with Gas System Design Experience** – this position has delegated authority by the Chief Engineer/Engineering Director (if the role exists within an organization) for approval of all standard designs. Approves all non-standard designs prior to approval of the Chief Engineer/Engineering Director and reviews and approves all gas work methods and procedures, including design and construction standard drawings, policies and procedures. The Technical Expert typically has a PE with a minimum of 3-5 years of day-to-day gas engineering and operational experience; or, in lieu of a PE, equivalent competency including extensive design, construction and operational experience.

Typically, this means greater than 6 years of practical experience with successful completion of related subject matter continuing education coupled with 2 years of design approval focus;

- **Engineering Manager/Supervisor** – this position is responsible for a group of engineers involved in the design process. The Engineering Manager/Supervisor coordinates approvals from other departments and stakeholder groups within the organization prior to submission to the Engineering Director and/or Technical Expert. The Engineering Manager/Supervisor is typically an engineer with 3-5 years of system design and operational experience. This position typically includes successful completion of a Gas Engineering Certificate Program and continuing education;

- **Design Engineer/Competent Person(s)** – a competent person for purposes of this document is defined as the designer, or anyone that serves a technical role in the design or the design review process. For an engineer involved with the design, this position typically requires a minimum of 1-3 years practical experience in gas engineering design and/or gas operations commensurate with the complexity of the project or design. The Designer shall demonstrate gas system design competency through documented education in an appropriate engineering discipline and/or through successful completion of a Gas Engineering Certificate Program.

4. Training, Education and Experience of Competent Person(s)

The experience of an EDR team requires each participating individual to be technically competent for the design being reviewed. For example, if the design review includes a new pressure regulator station that is not an approved standard design (complex non-standard design), and if a third party review is specified in an operator's specific policy, the Competent Person(s) reviewing this non-standard design must have design and operational experience with gas pressure regulator stations including knowledge of industry acceptable practices, conformance with applicable codes and standards, as well as organization specific procedures and standards.

An operator's specific EDR process policy should specify education and demonstrated experience requirements for individuals involved in the design and approval process. Education and demonstrated experience requirements shall be commensurate with the nature, scope and complexity of the design. The EDR process may allow for delegation of authority for subject matter areas beyond the scope of the approval authorities' subject matter area of expertise. A summary of recommended gas engineering design review process roles, education, experience and other qualifications is included in Appendix 4.

4.1 Professional Engineer or Equivalent Technical Expert

While most design reviews can be conducted by Technical Experts within an organization, an operator's EDR process should specify when use of a PE with appropriate gas engineering design/design review experience is required. The PE shall be required to practice within the authorized scope of his/her license authority rules and scope of practice. It is the PE's responsibility to be knowledgeable of any practice restrictions that are based on law or regulation, as well as those that relate specifically to the PE's area of professional competence.

The Technical Expert or PE with gas system design experience should have appropriate gas system engineering and operations experience, be knowledgeable and have demonstrated competence appropriate for the design review being performed.

For purposes of gas system design reviews, a PE equivalent Technical Expert is defined as an experienced design or design review engineer with 8-10 years of gas engineering/operations experience. The Technical Expert should possess an engineering degree in an appropriate engineering discipline or successfully completed a Gas Engineering Certificate Program with 6-8 years of associated experience.

NOTE: The GTI Competent Engineer Education and Assessment Program is one example of an assessment-based learning offering that covers all identified American Gas Association recommended competencies for natural gas utility engineers[4] as well as the competencies identified in the NGA Gas Engineering Design Review Guideline. New engineers can take GTI's Registered Gas Distribution Professional and/or GTI's Certified Gas Transmission Professional Certificate coursework and take the assessment to verify competence. Experienced engineers may take the assessment as a gap analysis to determine areas for improvement.

4.2 Gas Distribution Engineering

Training/coursework/experience to demonstrate competency in the gas distribution engineering discipline is typically operator defined. The following knowledge domains appropriate for and commensurate with a specific design scope of work and responsibility should be considered:

- Overview of the Natural Gas Industry (exploration and production, gathering, transmission, distribution, utilization of natural gas);
- Properties of natural gas;
- Federal and state pipeline safety regulations, consensus codes and standards;
- Organization operating policies and procedures (including PSSR's, PSMS, SOP process);
- Material properties and design considerations (plastic, steel, cast iron, wrought iron);
- MAOP design considerations;
- Distribution pipeline design (buried piping systems, mains and services);
- Distribution pipeline repair methods and considerations;
- Pipeline crossing design (highways, bridges, culverts, railroads, waterways);
- Pipeline construction/abandonment practices (open trench, trenchless installation methods);
- Welding of steel pipe;
- Destructive and non-destructive testing of weld joints;
- Joining of plastic pipe;
- Destructive and non-destructive testing of plastic joints;
- Mechanical joining;
- Pipeline tapping, by-passing and installation of stopples;
- Pressure testing;
- Purging;
- Uprating;
- Odorization;

[4] AGA White Paper April 8, 2019, Skills and Experience for Effectively Designing Natural Gas Systems.

- Fundamentals of corrosion and cathodic protection;
- Pipeline coating systems;
- Gas measurement principles;
- Meter types, applications, sizing and selection for distribution applications;
- Pressure regulation and over-pressure protection fundamentals;
- Regulator types, sizing and selection for distribution applications;
- Regulator control instability causes and cures;
- Over-pressure protection methods, sizing and selection for distribution applications;
- Design of residential and commercial measurement and pressure control runs;
- Design of large commercial and industrial measurement and pressure control runs;
- Design of district regulator stations;
- Gas conditioning requirements and equipment selection for distribution applications;
- Noise considerations for pressure regulating stations;
- System loads and methods for determining design loads;
- Fundamentals of gas control, SCADA and telemetry;
- Gas flow calculations, pipe sizing, hydraulic modelling and network analysis;
- Permitting, environmental protection, easements, surveying;
- Overview of GIS systems, maps, record keeping systems;
- OSHA and other government design, construction and safety standards; and
- The potential for job function Abnormal Operating Conditions (AOC's).

Suggested Formal Education Courses:

Competency may be demonstrated by formal documented on-the-job (OTJ) experience and/or a combination of formal OTJ experience, course work and continuing education courses. The course knowledge domains provided by an operator sponsored training program utilizing an industry recognized curriculum is one option; or a training/certificate program provided by a recognized industry organization, equipment or material manufacturer, using an operator approved curriculum.

A comprehensive course curriculum and certificate of completion supported by examination are highly recommended to substantiate successful completion of coursework. In addition, college equivalency or continuing education hours need to be provided if applicable.

As one example, the Gas Technology Institute (GTI) offers the following programs:

- Fundamentals of Gas Distribution (online course);
- Gas Distribution Engineering 1;
- Gas Distribution Engineering 2;
- Pipeline Safety Regulatory Compliance;
- Measurement & Regulator Station Design;
- Gas Distribution Operations;
- Registered Gas Distribution Professional;
- GTI Competent Engineer Exam.

4.3 Gas Transmission Engineering

In addition to the Gas Distribution Engineering knowledge domains discussed in Section 4.2, supplemental transmission system specific training/coursework/experience to demonstrate competency in a Transmission Engineering discipline must consider the following knowledge domains (as required by assets considered in a specific design):

- Transmission pipeline design, abandonment and pipeline repair methods and considerations;
- ILI technologies / smart pig design considerations for the pipeline system;
- Design of pig launching and receiving facilities;
- Design of automatic shutdown and remote-control valve systems (ACV & RCV);
- Pressure testing of transmission pipelines;
- Uprating of transmission pipelines;
- Purging of transmission pipelines;
- Meter types, applications, sizing and selection for transmission applications;
- Energy measurement and gas quality monitoring instrumentation;
- Regulator types, sizing and selection for transmission applications;
- Regulator control instability causes and cures;
- Over-pressure protection methods, sizing and selection for transmission applications;
- Design of industrial measurement and pressure control runs;
- Design of gate stations;
- Design of gas heating systems;
- Design of compressor stations;
- Odorization requirements, systems and design considerations;
- Gas conditioning requirements and design considerations for transmission applications;
- Noise considerations for pressure regulating stations and compressor stations.

Suggested Formal Education Courses:

Competency may be demonstrated by formal documented on-the-job (OTJ) experience and/or a combination of formal OTJ experience, course work and continuing education courses. The course work knowledge domains may be provided by an operator sponsored training program utilizing an industry recognized, operator approved curriculum; or a training/certificate program provided by a recognized industry organization, equipment or material manufacturer, using an operator approved curriculum.

A comprehensive course curriculum and certificate of completion supported by examination are highly recommended to substantiate successful completion of coursework. In addition, college equivalency or continuing education hours need to be provided if applicable.

As one example, the Gas Technology Institute (GTI) offers the following supplemental programs for Transmission Engineers:

- Gas Transmission Operations;
- Transmission Pipeline Design & Construction;
- Compressor Station Design;
- Certified Gas Transmission Professional Certification Program;
- GTI Competent Engineer Exam.

4.4 Gas Processing Engineering

In addition to the above coursework, supplemental training/coursework/experience to demonstrate competency in the Gas Processing Engineering discipline should include the following knowledge domains as appropriate for the design under review:

- Design, Construction and Operation of compressed gas fueling stations;
- Natural gas processing facilities including liquefaction cycles, tank storage systems and vaporization systems;
- Portable LNG vaporization facilities;
- Gas conditioning systems (beyond the scope of filters, strainers and heaters included; in Gas Transmission and Distribution Competencies);
- Portable pipeline compressed natural gas injection/supply systems.

Suggested Formal Education Courses:

Competency may be demonstrated by formal documented on-the-job (OTJ) experience and/or a combination of formal OTJ experience, course work and continuing education courses. The course knowledge domains provided by internal operator sponsored training programs utilizing an industry recognized, operator approved curriculum are one option; or a training/certificate program provided by a recognized industry organization, equipment or material manufacturer, using an operator approved curriculum. Examples of some industry organizations and relevant courses are provided below.

A comprehensive course curriculum and certificate of completion supported by examination are highly recommended to substantiate successful completion of coursework. In addition, college equivalency or continuing education hours need to be provided if applicable.

As one example, the Gas Technology Institute (GTI) offers the following programs:

- Compressor Station Design;
- LNG Plant Design and Operations;
- GTI Competent Engineer Exam.

Additionally, the Gas Processors Association (GPA) Midstream Association offers the following programs:

- GPA offers a comprehensive course and certification in the use of the GPSA Engineering Data Book; an industry recognized technical reference related to determining natural gas operating and design parameters for gas processing facilities.

5. Standard Engineering Design

Distribution pipeline operators are subject to multiple layers of safety regulations establishing an operator's requirement for materials of construction, design of facilities, construction and maintenance practices and a variety of requirements to ensure system integrity. These requirements provide a framework of checks and balances to ensure that facility construction, operation and maintenance are performed consistently and, more importantly, provide pipeline operators with the fundamental rules to ensure sustainable positive safety outcomes. To ensure compliance and conformance with the intent of this regulatory framework, operators are required to maintain written construction, maintenance and operations procedures.

These documents, including manuals and standards that are filed with various regulatory agencies and unfiled documents that provide organizations with consistent guidance in aspects of day-to-day operations and construction, are specific to an operator's scope of operations and its assets being managed. As a result, operators have developed a series of standard designs and construction requirements specific to their assets and systems which are reviewed and approved for use internally and by designated, properly trained and competent contractors. The approval process is somewhat unique to each operator but typically incorporates a layered, integrated EDR process utilizing trained and experienced SMEs familiar with an operator's specific assets and the operating environments in which these assets are installed. Site/project specific designs typically incorporate a series or combination of approved standard designs, procedures, materials of construction and construction practices. Below are essential elements of standard engineering designs and procedure review considerations that each pipeline operator should incorporate into a standard design process.

5.1 Defining Standard Engineering Design Activities

Each pipeline operator should define standard design and construction activities. The review and approval process however are not limited to engineering design, but includes construction requirements/practices, materials of construction, testing, commissioning and de-commissioning requirements including pre-startup inspections, and obtaining clearances (permission to work) during the commissioning/de-commissioning process.

Below are typical standard pipeline system design activities to consider:

- Distribution and transmission piping system design, construction and abandonment including associated appurtenances;
- Design, construction, installation and abandonment of service lines, valves and associated appurtenances;
- Design, construction and installation of customer metering systems;
- Design, construction and installation requirements of over-pressure protection systems;

- Design, construction and installation practices of system isolation valves;
- Design, construction and installation of district pressure regulating stations;
- Design, construction and installation of piping system bridge, road and railroad crossings;
- Changes to prior approved standard designs, materials of construction, field changes (as-built) and installation practices;
- System Operating Procedure (SOP) review support associated with non-emergency planned construction or maintenance requiring the shutdown or interruption of the gas distribution or transmission system and associated clearances (permission to work); gas main tie-ins and main extensions as well as service connections requiring control of gas pressure.

5.2 Review and Approval of Standard Engineering Design/Construction Practices

Pipeline operators should develop a Standard Design/Construction Practices design review process that is:

- Appropriate for the level of complexity of the standard design/construction practice.
- Multi-layered, providing a multi-disciplined approach that is commensurate with scope and scale of the subject matter under design review;
- Conducted by competent individuals with direct knowledge of the technical subject matter under review;
- Includes final approval and sign off by a position of authority, typically an Engineering Manager/Supervisor and/or Engineering Director/Technical Expert;
- Ensures that personnel responsible for design and/or design implementation shall be appropriately trained in the design review process;
- Includes a process for assessing design/operational risk assessment, where appropriate, including identification of potential abnormal operating conditions (AOC's) resulting from design implementation;
- Includes consideration and development support, based on design/operational risk, of a Pre-Startup Safety Review process, System Operating Procedure process where required;
- Includes a continuous improvement review process for previously approved designs including a prescribed frequency of review (typically code mandated).

6. Complex and Non-Standard Engineering Design

Non-standard design, construction practices and procedure reviews are defined as proposed work that falls outside of the scope of *approved standard designs*, and/or where it is prudent based on a risk assessment or an organization's policy, that an independent review by a competent person(s) is warranted. This independent third-party review is typically conducted by a Technical Expert or PE with gas system design experience. The review and approval process include engineering design, construction requirements/practices, materials of construction, testing, application of commissioning and de-commissioning requirements such as pre- startup inspections and obtaining clearances (permission to work) during the commissioning/de- commissioning process.

6.1 Defining Complex and Non-Standard Design Activities

Below are examples of where a Complex, Non-Standard EDR should be considered:

- Design, construction and commissioning of a new, or reconfiguration of a District Pressure Regulating Station or Custody Transfer Station where reconfiguration is defined as any significant design change that may change original design operational variables such as capacity, pressure relieving systems, control lines and control systems, operational monitoring characteristics or equipment substitutions (other than like for like equipment replacement);
- Pipeline construction, abandonment and maintenance activity in the vicinity (as defined in company procedures or policies) of pressure regulation stations with focus on review and confirmation requirements of station monitoring and control points, sensing line locations and/or activity that may result in a system over pressurization and/or under pressurization AOC's;
- Uprating of distribution and transmission pipelines that are beyond the scope of standard uprate operating procedures with attention to end-use customer requirements, MAOP review of the pipeline, leak survey requirements, critical valve and isolation valve locations, overpressure protection and district regulator stations within the scope of the uprate;
- Complex design,construction and abandonment associated with distribution and transmission pipelines. Complex construction includes a design that is not included in an approved standard design that may involve multiple/complex tie-in's, systems requiring installation of a by-pass to maintain system pressure, and designs that impact system design pressures or other designs as determined by a risk assessment that a third-party review is recommended;
- Complex design and construction or significant modifications (as determined by a risk assessment) of compressor stations, LNG facilities, CNG vehicle fueling facilities, portable pipeline facilities and custody transfer (City Gate) stations.

6.2 Review and Approval of Complex, Non-Standard Designs and Construction Practices

Pipeline operators should consider development of a non-standard design/construction and operating practices EDR process that is:

- Fit-for-purpose, depending on the complexity of the non-standard design/construction practice and risk assessment if required;
- Multi-layered, providing a multidisciplined approach that is commensurate with the scope of the subject matter under design review;
- Conducted by competent, experienced individuals, typically a PE with gas engineering design experience or equivalent Technical Expert, with direct knowledge of the technical subject matter under review;
- Optional third-party reviews performed by external firms require final approval and formal sign off by a technical executive in the pipeline organization;
- Personnel responsible for design and/or design implementation shall be appropriately trained in the design review process;

- Includes a process for assessing design/operational risk assessment, where appropriate, including identification of potential AOC's resulting from design implementation;
- Includes, based on design/operational risk, a Pre-Startup Safety Review process and System Operating Procedure process where appropriate;
- Includes a process for construction pre-execution review with appropriate construction personnel including contractors.

7. Management of Change Policy/Operational Controls

The pipeline operator must establish a design approval management of change (MOC) policy that describes operational and administrative requirements and responsibilities. The MOC policy includes an approval process for field changes to previously approved standard/non-standard designs and/or associated system operating procedures. The MOC process should consider re-evaluation of previously approved designs that were not executed within the prescribed time frame (delayed projects) regardless of the reason for delay.

The pipeline operator should identify the potential risks associated with the change, execution delays and any required additional reviews and approvals prior to implementing the change. These changes include but are not limited to technical design, equipment specifications, system operation procedural modifications, project organizational changes (including any changes with assigned resources/contractors) and scope changes. The policy should consider permanent or temporary changes in addition to planning for the effects of the change for each situation.

The approval process for proposed changes to both standard and non-standard designs is based on the relative significance of the proposed change as determined by the original design engineer or designated alternate.

Design changes can be categorized into two Tiers:

Tier I – a field change that does not materially alter the fundamental design and will not alter ultimate operation of the pipeline, as determined by collaboration of the design/construction team SME's, relative to the original approved design. Tier I change(s) requires Design Engineer approval and, in some cases, as prescribed in an operator's policy, Design Engineer Supervisor/Manager approval;

Tier II – a design change that significantly alters the approved design and may result in operational changes of the pipeline (flows, pressures, temperatures, reliability, etc.) as determined by a risk assessment. Tier II change(s) requires a review equivalent to the original EDR - including, approval by the Engineering Director/Technical Expert, and, in some cases, the Engineering Executive.

NOTE: A delay in design construction execution, as defined in an operator's EDR policy, of a previously approved site-specific design should be considered a Tier II design change. This requires careful consideration as site operating variables, piping configurations and original design assumptions may have changed since it was originally reviewed**.** A post-change pre-execution review meeting should be considered including construction contractors as appropriate.

The pipeline operator's gas system EDR MOC policy should consider the following:

- Reason for change;
- Authority for approving changes;
- Analysis of implications;
- Assessment of potential work permit changes resulting from the design change;
- Documentation of change process;
- Communication of change to effected members of the project/construction team including additional pre-execution review meetings with associated contractor(s);
- Time limitations / scheduling;
- Reassessment of resources;
- Any resulting changes to construction staff qualifications and training (including contractors);
- Delays in execution of a site-specific design that may trigger re-examination of the original design and/or associated system operating procedure; and
- Any additional work or operating system changes beyond the scope of the originally proposed design or project work scope, in the same geographic area, which may have implications on the proposed change (overlapping work scope) or where the proposed change has implications on other projects/work.

8. Safety Assurance

Leadership should formalize EDR conformance assessments and develop associated metrics to monitor risk reduction results associated with the EDR process. These conformance assessments should consider:

- Identification of personnel to observe the conformance of parties engaged in the review and assess whether an adequate number of layers of protection are in place, appropriate to the design project's complexity;
- Assess how well documents are understood and if they are adequately accessible to support the EDR process;
- Observe the extent of transparency and accountability throughout the design, construction, and inspection process.

Organizations should consider developing and executing a plan for auditing the effectiveness of the Engineering Design Review process and review results in a Management Review. Metrics can be drawn from the list described below in item 9. The plan should determine if corrective actions are appropriately taken and establish a schedule for implementation, consistent with API RP 1173. The plan should also stimulate the involvement of employees regardless of position to make recommendations and contribute to decisions. One should consider as part of the audit process the extent of incident investigation and lessons learned, procedures for identifying incidents to investigate, adequacy of procedures to determine cause and how well corrective actions are assigned, monitored and tracked. The plan should have provisions to determine if there is any potential for abuse of the Delegation of Authority to subject matter experts not adequately prepared.

9. Continuous Improvement Practices Related to Engineering Design/Management Review

The pipeline operator's gas system EDR policy should include a continuous improvement process. Appropriate data should be reviewed and evaluated to ensure the pipeline or facility design is operating as intended. Each standard design, construction procedure and associated procedures for commissioning and de-commissioning of facilities should be periodically reviewed, at a minimum, in accordance with any code specific requirements. Periodic reviews should include metrics on the following, which will be monitored during the management review process:

- Stakeholder feedback, including feedback from field personnel involved in both construction and operations (including contractors);
- Equipment reliability, performance and availability;
- Gas system operational performance;
- Equipment manufacturer notifications;
- Incident investigations, near-miss evaluations and lessons learned;
- Changes in policies and codes; and
- Results of risk management reviews, internal and external audits.

The output of the continuous improvement periodic reviews of gas system designs should include a summary of changes to specific designs, feedback integration into the MOC process, and communication of change resulting from these reviews, including feedback to training organizations.

10. Documentation and Recordkeeping

The pipeline operator's gas system EDR policy should include requirements for identification, distribution and control of documents to memorialize the review process. The policy should specify responsibilities for document approval/sign-off and re-approval, and identify controls needed to assure that appropriate documents required to support the EDR process, construction and commissioning/de-commissioning process are readily available and accessible to workers performing an activity, and that they remain legible and readily identifiable. One should evaluate how consistently documents are accessed and determine if there are areas of the organization where access is a concern.

These documents typically include:

- Design drawings and sketches;
- Calculations;
- Materials of construction;
- Field construction data such as pipe joining records, system testing records including pressure testing records, etc.; and
- Work package data, including commissioning/de-commissioning PSSR's and SOP's.

11. Summary and Conclusions

EDR, as applied to gas system construction and operations, is an essential process that is fundamental in controlling construction and operational risk. EDR is a process executed by competent individuals and/or teams of individuals that have demonstrated subject matter experience coupled with, in some cases, practical operational and construction experience. The process is scalable, with the level of review and approval commensurate with the complexity of the design. The defense-in-depth strategy to minimizing and reducing operational risk associated with gas system engineering designs is underpinned by a layered approach of review. In summary, a comprehensive, consistently executed organizational policy that incorporates a layered approach of review utilizing competent individuals, commensurate with the complexity of the design, will result in maximizing public safety value.

APPENDIX

1. Sample Review Process for Standards, Procedures & Construction Practices

2. Sample Review Process for Application of Standard Designs to Site Specific Projects

3. Sample Review Process for Site/Project Specific Complex, Non-Standard Designs

4. Gas System Engineering Design Review Roles, Responsibilities and Qualification Considerations

5. References

6. Sample Complex Design & Construction Review Checklists

   A. Intrastate Transmission Pipelines
   B. Distribution Pipelines
   C. District Pressure Regulator Stations
   D. Gate Stations
   E. Bridge & Railroad Crossings
   F. Uprating Intrastate Transmission and Distribution Pipelines

7. Sample System Operations Procedure (SOP)

8. Sample Pre-Startup Safety Review Checklist

9. Sample Change Control Procedure for Construction Projects

10. EDR Guideline Safety Management System Conformance Independent Assessment

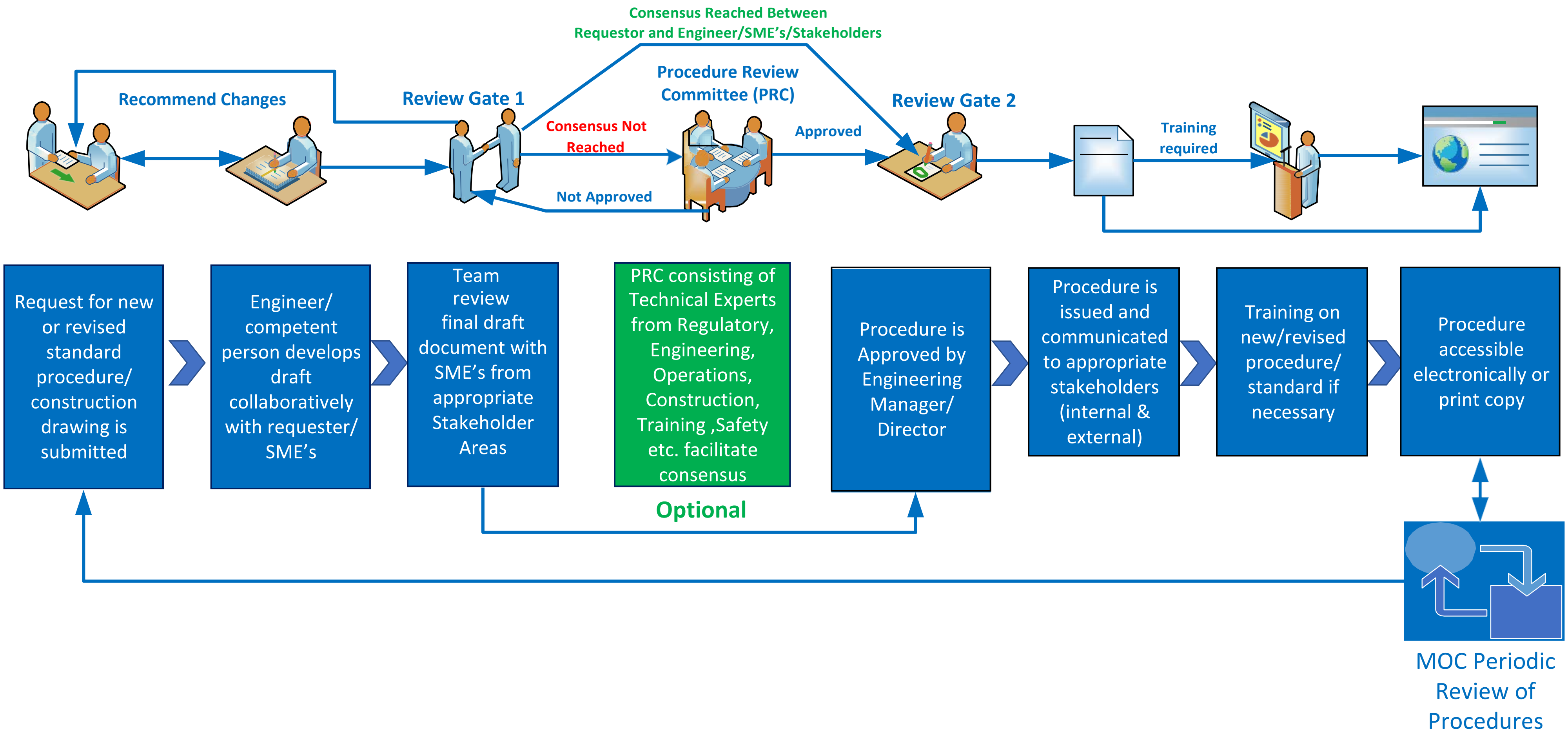
Note:

The SAMPLE Checklists and Procedures are intended to provide operators with examples and a framework for consideration in development of company specific checklists and procedures. It is further recognized that the complexity of each design and company specific operating assets may vary and as a result, each operator should carefully examine the applicability of the Appendix documents contained within this Guideline.

Appendix 1

Sample Review Process for Standards, Procedures & Construction Practices

Appendix 1 Sample Review Process for Standards, Procedures & Construction Practices

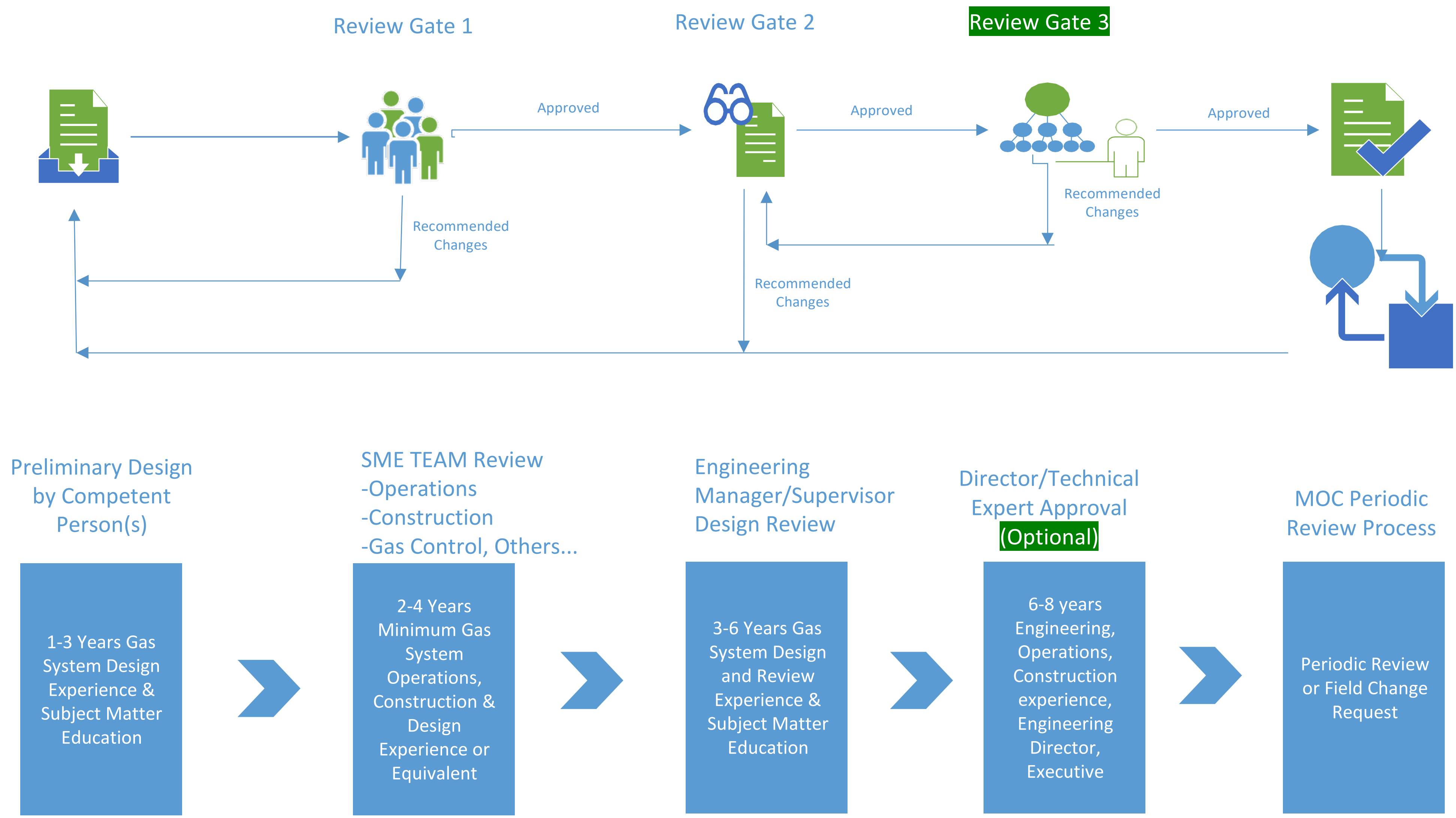


Note: ***This process may vary structurally and by organization however should be included in each company specific Design Review Policy or Procedure.*** The procedure/construction drawing development & MOC process typically includes *1-2 Review Gates* prior to final approval depending on the complexity of the procedure, stakeholder impacts and the ability to reach consensus among stakeholders. In some larger organizations, a "Procedure Review Committee", or PRC, is used to build consensus around a proposed process change the SME's cannot reach agreement on. Final approval is typically by the Engineering Standards & Procedures Manager/Director. More complex procedures, designs, drawings may include development by and/or independent external review by a competent third party.

Appendix 2

Sample Review Process for Application of Standard Designs to Site Specific Projects

Appendix 2 Sample Review Process for Application of Standard Designs to Site Specific Projects

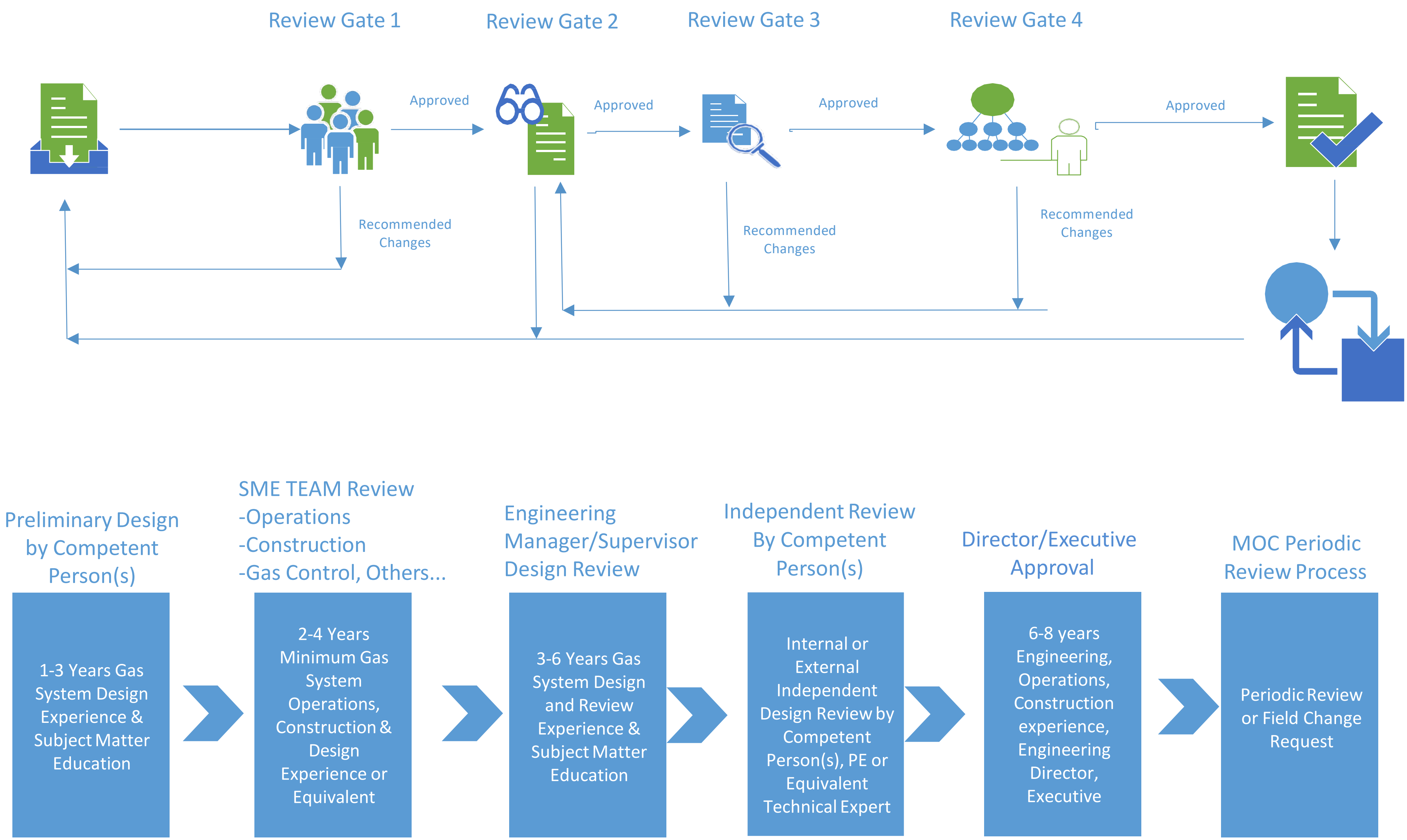


Note: Depending on the complexity of the standard design, the size and scale of company specific operations, the review process may incorporate *2-3 levels of review*. In many cases, the Preliminary Design by a Competent Person incorporates a “design team” combining the SME Team review with work by the Designer, then reviewed and approved by the Engineering Manager/Supervisor (***essentially a two-step process***). For more complex standard designs, or larger, organizations managing more complex systems, the process may be expanded as shown above to include optional review by the Engineering Director/Technical Expert or for routine designs on a “spot check” periodic basis. Regardless of size/scale of an organization or standard design complexity, the Process MUST include design review gates, review by competent person(s) with final approval by a position of authority. ***The key to maximizing public safety value and system reliability associated with gas engineering designs is in the “layers of protection” a properly executed design review process results in rather than relying on a single level review by an individual.***

Appendix 3

Sample Review Process for Site/Project Specific Complex, Non-Standard Designs

Appendix 3 Sample Review Process for Site/Project Specific Non-Standard Designs



Note: Like the Standard Design Review Process, the Non-Standard review process *is scalable based on project complexity*, the size of a company and complexity of assets being managed. A fundamental element in Non-Standard Design Review is the independent review by Competent Person(s). In this case, Competent Person(s) is defined as an ***internal employee OR contractor*** with a PE **AND** associated gas experience in the subject matter under review (minimum 3- 5 years' experience) OR ***equivalent*** Technical Expert which includes an experienced gas engineering professional with an engineering degree in an appropriate discipline with 6-8 years' experience and successful completion of a Gas Distribution/Transmission Engineering Certificate Program and associated continuing education. Review Gate 3 & 4 should be considered based on the complexity of design / design change as described in a company specific EDR process.

Appendix 4

Gas System Engineering Design Review Roles, Responsibilities and Qualification Considerations

Gas System Engineering Design Review Role & Responsibility Summary / Associated Qualifications

NOTE: These are *examples* of typical process roles however these roles may not be present in every company. The company specific gas engineering design review policy shall define roles and responsibilities.

Process Responsibility: Engineering Executive

Description: overall engineering design end-to-end process responsibility including personnel responsible for gas system designs from concept through final approval. Additional responsibilities include overall team leadership and process conformance, compliance with all local, state and federal design requirements, design conformance with applicable company standards, work methods, procedures and policies.

Required Education: B.S. in an appropriate Management/Business Administration or Engineering Discipline, advanced degree, P.E. or equivalent preferred however not required.

Gas System Experience: 6-8 years of progressive responsibility and leadership in gas operations management, engineering or construction.

Additional Recommended Education / Certification: Advanced professional training and continuing education related to pipeline operations regulatory requirements, gas engineering design, construction and operations and Pipeline Safety Management Systems (PSMS) leadership, overall multi-disciplinary gas business background.

Process Responsibility: Chief Engineer/Engineering Director

Description: this position has authority for all final engineering reviews and sign off for all design types (standard, complex non-standard, etc.) and in some cases, directly reviews more complex high-risk designs. The scope of this role typically includes final review of policies associated with design, approvals, management of change, process safety and pre-startup review policies.

Required Education: B.S. in an appropriate Engineering Discipline, advanced degree, P.E. or equivalent is preferred however not required.

Gas System Experience: minimum 6-8 years (typically greater than 8 years) of progressive responsibility and leadership in gas operations, engineering or construction.

Process Responsibility: Chief Engineer/Engineering Director (Cont'd)

Additional Recommended Education / Certification: Advanced professional training and continuing education related to gas engineering design, construction and operations and Pipeline Safety Management Systems (PSMS) leadership and other professional gas system coursework.

Process Responsibility: Technical Expert / Professional Engineer (PE) with Gas System Design Experience

Description: responsible for impartial review independent of the Design Engineer or Engineering Project Development Team (Design Engineer(s), SME Review and Engineering Manager Review). Review typically reserved for complex, site/project specific non-standard engineering designs typically performed by a Licensed Professional Engineer (PE) with demonstrated subject matter experience, or documented extensive gas system design, operations and/or construction experience OR Equivalent Technical Expert.

Required Education: B.S. in an appropriate Engineering Discipline, advanced degree preferred, P.E. or equivalent Technical Expert (which includes successful completion of the Registered Gas Distribution Professional Program and/or the Certified Gas Transmission Professional (CGTP) Program) or comparable gas system design review certification from a company approved continuing education provider.

Gas System Experience: With a P.E., minimum 3-5 years practical gas system design, operations and/or construction experience. P.E. equivalent competency (in lieu of a PE) includes extensive design, construction and operational experience. Typically, this means greater than 6 years of practical experience with successful completion of related subject matter continuing education coupled with 2 years of *design approval focus.*

Additional Recommended Education / Certification: For P.E. equivalent status, successful completion of the GTI Registered Gas Distribution Professional Program AND/OR Certified Gas Transmission Professional Program (CGTP) or comparable gas system design certification program from a company recognized continuing education provider. Advanced professional training and continuing education related to subject matter under review including gas processing facility design, construction and operational reviews.

Process Responsibility: Engineering Manager / Supervisor

Description: engineering team supervisory role, responsible for engineering design area(s) and for design engineer leadership and development. Responsibilities include ensuring engineering design process conformance with all designs in addition to technical oversight and approvals in accordance with all local, state and federal code requirements, company specific procedures and industry acceptable practices.

Process Responsibility: Engineering Manager / Supervisor (Cont'd)

Ensure design packages are complete including commissioning and decommissioning procedure references and/or development.

Required Education: B.S. in an appropriate Engineering Discipline, advanced degree preferred or equivalent Technical Expert (which includes successful completion of the Registered Gas Distribution Professional Program and/or the Certified Gas Transmission Professional (CGTP) Program) or comparable gas system design review certification from a company approved continuing education provider.

Gas System Experience: 3-5 years practical design approval experience.

Additional Recommended Education / Certification: Participation in GTI Registered Gas Distribution Professional Program or other professional gas system coursework working towards Certificate with Operations or Engineering focus.

Process Responsibility: Design Engineer / Competent Person(s)

Description: responsible for development of assigned engineering design, developing operating or maintenance procedures associated with pipelines/pipeline facilities (see 49 CFR 191.3) and/or member of the design review team (including SME's) focused on design operability, constructability, pipeline safety and system reliability.

Required Education: B.S. in an appropriate Engineering Discipline preferred, OR practical gas operations, construction and/or gas control experience as specified below.

Gas System Experience: 1-3 years practical design experience with B.S., 4-8 years related operational/gas construction experience without an engineering degree.

Additional Recommended Education / Certification: Participation in GTI Registered Gas Distribution Professional Program or other professional gas system coursework working towards Certificate with Operations or Engineering focus. For non-degree SME's, professional training and continuing education related to subject matter under review or other gas system coursework.

Appendix 5

References

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Appendix 6

Sample Complex Design & Construction Review Checklists

A. Intrastate Transmission Pipelines
B. Distribution Pipelines
C. District Pressure Regulator Stations
D. Gate Stations
E. Bridge & Railroad Crossings
F. Uprating Intrastate Transmission & Distribution Pipelines

Appendix 6-A Sample Design Review Checklist - Transmission Pipeline		
Project Name:		
City/Town:		
WO#:		
Engineer:		
Design Review By:		
Design Std:	*Design of Transmission Lines and Pipelines with MAOPs of 125 PSIG or Greater*	

TASK	REFERENCES	DATE or N/A
PROJECT FILE		
Verify Scope of work (project initiation form and scope document).		
-Confirm that scope document was routed appropriately.		
Verify Process Hazard Assessment (PHA) review form completed.		
-Confirm any action items are closed.		
Verify Project Complexity Score.		
DESIGN DRAWINGS		
Review design cover page for appropriate information.		
-Location, length, diameter, pressure, etc.		
Verify that construction/design notes are complete.		
-Weld X-Ray requirements CWI, GPS, etc.		
-Wall thickness, grade		
-Pressure test requirements.		
-MAOP, MOP, % SMYS, etc.		
-Verify Corrosion Review of design and comments incorporated in plans.		
-Review SMYS calcs, verify proper wall thickness and strength for all components.		
Review valve design/utilization.		
-Verify line valves located every mile.		
-Verify purge points between all main valves per Company Standards.		
-Verify proper valve support for valves 12-inch and larger.		
-Verify requirement and design for Remotely Operated Valves.		
Review tie-in details		
Verify design is piggable, 3R elbows, barred tees, etc.		
Verify that launcher / receiver design (perm or temp) in accordance with design standards.		
Verify that a odorant pickling procedure is incorporated into the design (>2500').		
Confirm that appropriate markers are included in design.		
Verify materials are specified with appropriate level of detail.		
-Identified as stock or non-stock and responsible supplier.		
-Confirm all materials on order or on schedule based on time of review.		
-Coatings are specified.		
Verify any special permitting requirements.		
-Confirm design in accordance with any special permit requirements.		
Review for special roadway crossings/ foreign utilities.		
Schedule design hold point 1 design/construction review meeting.		
Determine if NYS PSC Article VII filing and Environmental Review (NYS)		

Appendix 6-A Sample Design Review Checklist - Transmission Pipeline	
Project Name:	
City/Town:	
WO#:	
Engineer:	
Design Review By:	
Design Std:	*Design of Transmission Lines and Pipelines with MAOPs of 125 PSIG or Greater*

TASK	**REFERENCES**	**DATE or N/A**
WORK PACKAGE		
Confirm all appropriate forms are included in the work package.		
Pressure test form, with top part of form completed.		
Review Draft SOP.		
-Confirm time/temp restrictions are included.		
-Confirm pre-heat and post bake needs are included.		
Review estimate.		
Signed Delegation of Authority (DOA).		
-Confirm updated estimate reflected in DOA.		
NYS DPS 30 Day Notice of Proposed Construction including construction start date (NY only)		
POST Design Review		
Update Project List.		
Elevate any process / design concerns or roadblocks, etc. to HUB board.		
Send drawings for any applicable state permit / grant of location.		
Incorporate any changes from TVC Hold Point 1 Meeting.		
Develop construction bid specs.		
Reinforce TVC Requirements.		
-CMTR Calculations completed and sent to Transmission Engineering for approval.		
POST CONSTRUCTION		
Send copy of pressure test report to PSC certifying MAOP of pipeline (NY only)		
Update "Issued for Construction" drawings based on "As-Built" conditions		
Send copy of As-Built drawings to Mapping		
Send copy of As-Built drawings Damage Prevention		

Other Notes/Comments, Company Specific Procedure References:

Appendix 6B Sample Design Review Checklist - Distribution Pipeline

Project Name:	
City/Town:	
WO#:	
Engineer:	
Design Review By:	
Design Std:	*Design of Distribution Mains*

TASK	REFERENCES	DATE or N/A
PROJECT FILE		
Verify Scope of work (project initiation form and scope document).		
-Confirm that scope document was routed appropriately.		
Verify Project Complexity Score.		
DESIGN DRAWINGS		
Review design cover page for appropriate information.		
-Location, length, diameter, pressure, etc.		
Verify that construction/design notes are complete.		
-Weld X-Ray requirements		
-Wall thickness, grade		
-Pressure test requirements.		
-MAOP, MOP, % SMYS, etc.		
-Verify Corrosion Review of design and comments incorporated in plans.		
-Review SMYS calcs, Verify proper wall thickness and strength for all components.		
Verify that valves are located for appropriate isolation, sectionalizing, etc.		
-Verify proper valve support for valves 12-inch and larger.		
Review tie-in details		
Verify details are appropriate for abandonment of existing main.		
Verify that a odorant pickling procedure is incorporated into the design (>2500')		
Verify materials are specified with appropriate level of detail.		
-Identified as stock or non-stock and responsible supplier.		
-Confirm all materials on order or on schedule based on time of review.		
-Coatings are specified.		
Verify any special permitting requirements (e.g. R/R, DOT, etc).		
-Confirm design in accordance with any special permit requirements.		
Review for special roadway crossings/ foreign utilities.		
WORK PACKAGE		
Confirm all appropriate forms are included in the work package.		
Review Draft SOP.		
-Confirm time/temp restrictions are included.		
Review estimate.		
Signed Delegation of Authority (DOA).		
-Confirm updated estimate reflected in DOA.		
POST DESIGN REVIEW		
Update Project List.		
Elevate any process / design concerns or roadblocks, etc. to Executive		
Send drawings for any applicable state permit / grant of location.		
Other Notes/Comments, Company Specific Procedure References		

Appendix 6C Sample Design Review Checklist- District Pressure Regulator Station

Project Name:	
City/Town:	
WO#:	
Engineer:	
Design Review By:	
Design Std:	*Design of Gas Regulator Stations*

TASK	REFERENCES	DATE or N/A
PROJECT FILE		
Verify Scope of work (project initiation form and scope document).		
-Confirm that scope document was routed appropriately.		
Verify station ownership, O&M agreements, custody transfer, etc.		
Verify Process Hazard Assessment (PHA) review form completed.		
-Confirm any action items are closed.		
Verify Project Complexity Score.		
DESIGN DRAWINGS		
Review design cover page for appropriate information.		
-Location, length, diameter, pressure, etc.		
Verify that construction/design notes are complete.		
-Weld X-Ray requirements		
-Wall thickness, grade		
-Pressure test requirements.		
-MAOP, MOP, % SMYS, etc. (MAOP confirmed with asset owner).		
-Verify Corrosion Review of design and comments incorporated in plans.		
-Review SMYS calcs, Verify proper wall thickness and strength for all components.		
-Confirm SMYS <20% for all components.		
-Confirm that the entire station from inlet to outlet valve is designed for inlet MAOP.		
Review regulator selection, sizing calculations, and overpressure protection.		
Review pipe sizing for velocity, vibration and noise potential.		
Review valve design/utilization.		
-Verify appropriate placement of inlet/outlet valves.		
-Verify appropriate use of gate/ball/valve.		
Confirm that controls lines are designed in a safe location and per standard. New control lines in the public ROW should be at least 1-1/4" SCH80.		
Verify appropriate civil details, for building, supports, etc.		
Verify inclusion of a grounding plan if applicable.		
Verify complete electrical/control designs. SCADA location, power, comms.		
Confirm vent poles are utilized for vaults as needed.		
Verify lightning protection at insulating flanges for above grade transitions.		
Verify motion detection, intrusion, gas detection, etc.		
Verify materials are specified with appropriate level of detail.		
-Identified as stock or non-stock and responsible supplier.		
-Confirm all materials on order or on schedule based on time of review.		
-Coatings are specified.		
Confirm appropriate level of detail for abandonment of existing station **and control lines**.		
Verify any special/building permitting requirements.		
-Confirm design in accordance with any special permit requirements.		

Appendix 6C Sample Design Review Checklist- District Pressure Regulator Station

Project Name:	
City/Town:	
WO#:	
Engineer:	
Design Review By:	
Design Std:	Design of Gas Regulator Stations

TASK	REFERENCES	DATE or N/A
WORK PACKAGE		
Confirm all appropriate forms are included in the work package (work package, Environmental, maps, service info, records, etc.).		
Review Draft SOP.		
-Confirm time/temp restrictions are included.		
Review estimate.		
Signed Budget/Spend Approval Delegation of Authority (DOA).		
-Confirm updated estimate reflected in DOA.		
POST Design Review		
Update Project List.		N/A
Elevate any process / design concerns or roadblocks, etc. to Engineering		N/A
Develop construction bid specs		N/A

Other Notes/Comments: References include any Company Specific Procedures No's, Policies etc.

Appendix 6D Sample Design Review Checklist - Gate Station

Project Name:	
City/Town:	
WO#:	
Engineer:	
Design Review By:	
Design Std:	*Design of Gas Regulator Stations*

TASK	REFERENCES	DATE or N/A
PROJECT FILE		
Verify Scope of work (project initiation form and scope document).		
-Confirm that scope document was routed appropriately.		
Verify station ownership, O&M agreements, custody transfer, etc.		
Verify Process Hazard Assessment (PHA) review form completed.		
-Confirm any action items are closed.		
Verify Complexity Score.		
DESIGN DRAWINGS		
Review design cover page for appropriate information.		
-Location, length, diameter, pressure, etc.		
Verify that construction/design notes are complete.		
-Weld X-Ray requirements CWI, GPS, etc.		
-Wall thickness, grade		
-Pressure test requirements.		
-MAOP, MOP, % SMYS, etc. (MAOP confirmed with asset owner).		
-Verify Corrosion Review of design and comments incorporated in plans.		
-Review SMYS calcs, Verify proper wall thickness and strength for all components.		
-Confirm SMYS <20% for all components.		
-Confirm that the entire station from inlet to outlet valve is designed for inlet MAOP.		
Review regulator selection, sizing calculations, and overpressure protection.		
Review pipe sizing for velocity.		
Review valve design/utilization.		
-Verify appropriate placement of inlet/outlet valves.		
-Verify appropriate use of gate/ball/valve.		
Confirm that controls lines are designed in a safe location and per standard.		
Verify appropriate civil details, for building, supports, etc.		
Verify inclusion of a grounding plan if applicable.		
Verify complete electrical and control designs.		
Verify lightning protection at insulating flanges at above grade transitions.		
Verify motion detection, intrusion, gas detection, etc.		
Verify odorant is acceptable: system, volume, odorizer, containment.		
Verify materials are specified with appropriate level of detail.		
-Identified as stock or non-stock and responsible supplier.		
-Confirm all materials on order or on schedule based on time of review.		
-Coatings are specified.		
Verify any special/building permitting requirements.		
-Confirm design in accordance with any special permit requirements.		
Schedule hold point 1 design/construction review meeting.		
Determine if PSC Article VII filing needed (NYS)		

Appendix 6D Sample Design Review Checklist - Gate Station

Project Name:	
City/Town:	
WO#:	
Engineer:	
Design Review By:	
Design Std:	*Design of Gas Regulator Stations*

TASK	REFERENCES	DATE or N/A
WORK PACKAGE		
Confirm all appropriate forms are included in the work package.		
-Confirm as needed		
Pressure test form, with top part of form completed.		
Review Draft SOP.		
-Confirm time/temp restrictions are included.		
-Confirm pre-heat and post bake needs are included.		
Review estimate.		
Signed Delegation of Authority (DOA).		
-Confirm updated estimate reflected in DOA.		
PSC 30 Day Notice of Proposed Construction including construction start date (NY Only)		
POST Design Review		
Update Project List.		
Elevate any process / design concerns or roadblocks, etc. to Executive		
Incorporate any changes from Hold Point 1 Meeting		
Develop construction bid specs		
Reinforce TVC Requirements.		
CMTR Calculations completed and sent to Pressure Regulation Engineering for Approval.		
POST CONSTRUCTION		
Send copy of pressure test report to PSC certifying MAOP of pipeline (NY		
Update "Issued for Construction" drawings based on "As-Built" conditions		
Send copy of As-Built drawings to Mapping		
Send copy of As-Built drawings Damage Prevention		

Other Notes/Comments, Company Specific Procedures:

Appendix 6E Sample Design Review Checklist- Pipeline Bridge Crossings		
Project Name:		
City/Town:		
WO#:		
Engineer:		
Design Review By:		
Design Std:	Design Requirements for Installation of Gas Main on Bridges	

TASK	REFERENCES	DATE or N/A
COMPLETE TRANSMISSION OR DISTRIBUTION CHECKLIST IN ADDITION TO THE FOLLOWING:		
Verify appropriate placement of pipe and constructability.		
-Not lowest hanging component or subject to damage, etc.		
-Equipment needed for access or installation. Barges, scaffolding, etc.		
-Is existing piping in the way of proposed?		
-Will removal of existing piping require other additional measures/equipment and effect of permitting?		
-Confirm appropriate permits and real estate access needed is identified.		
Confirm calculations are all performed in accordance with bridge requirements for pipe support and bridge attachment.		
-Verify max support spacing is adequate.		
-Verify the need for an expansion joint.		
Verify appropriate detail for pipe roller/hardware, attachment bracket, and coating of these materials. Include all anchors and any other materials or equipment that require special order and fabrication. Special drill bits, etc.		
Verify appropriate detail for bridge abutments and materials needed.		
Verify isolation valves on both sides of the bridge.		
Verify appropriate coating for bridge pipe.		
Weld X-Ray requirements, 100% on bridges.		
(MA Only) Review DPU bridge letter for appropriate detail and format.		
POST Design Review		
Submit bridge design to appropriate permit agency for bridge ownership.		
(MA Only) Send bridge letter to DPU for approval of the installation.		
Send critical valve information to Operations Engineering.		
Other Notes/Comments, Company Specific Procedures		

Appendix 6E Sample Design Review Checklist - Railroad Crossings

Project Name:	
City/Town:	
WO#:	
Engineer:	
Design Review By:	
Design Std:	*Design Requirements for Installation of Casings (5.3 Railroad Crossings); Casing installations*

TASK	REFERENCES	DATE or N/A
COMPLETE TRANSMISSION OR DISTRIBUTION CHECKLIST IN ADDITION TO THE FOLLOWING:		
Verify appropriate placement of crossing and constructability.		
-Adequate space for excavations, equipment, etc. for boring.		
-Appropriate location for casing vents.		
Confirm design and calculations are performed in accordance with AREMA or applicable railroad owner/agency.		
-Adequate depth of cover.		
-Verify test borings and/or pits completed (if necessary).		
Verify appropriate detail for casing and materials needed.		
Verify isolation valves on both sides of the railroad.		
Verify appropriate cathodic protection for carrier and casing.		
Confirm appropriate permits and real estate access needed is identified.		
POST Design Review		
Work with real estate to submit permit and establish insurance needs, etc.		
Send critical valve information to Operations Engineering.		

Other Notes/Comments, Company Specific Procedures

Appendix 6F Sample Design Review Checklist - Upratings

Project Name:	
City/Town:	
WO#:	
Engineer:	
Design Review By:	
Design Std:	Uprating Pipelines to 125 psig or Greater; Uprating Pipelines to Less than 125 PSIG

TASK	**REFERENCES**	**DATE or N/A**
TRANSMISSION OR DISTRIBUTION CHECKLIST MAY BE NECESSARY FOR DESIGN OF MAINS IN ADDITION TO THE FOLLOWING:		
Review Pre-Uprating Checklist		
-Verify review of all mains.		
-Verify review of all services and customer/address list.		
-Verify receipt of all pressure test records.		
-Verify review of corrosion history.		
'-Verify review of impacted regulator stations.		
-Verify review of leak history.		
-Verify operations regulatory compliance notification/review.		
-Verify pre-uprate meeting scheduled/complete.		
-Verify pre-uprate service inspection scheduled/complete.		
-Verify pre-uprate leak survey scheduled.		
-Verify DPU notification.		
Review Uprating Procedure		
-Verify source of pressure increase.		
-Verify system separation (connection and abandonment detail).		
-Verify system checkpoints.		
-Verify pressure chart location.		
-Review Draft SOP		
Review Post-Uprating Checklist		
Verify proper NGA operator qualification (Task 28 & 70).		
Verify complete uprate binder		
Verify design in accordance with company standard.		
Verify design in accordance with 49 CFR 192 Subpart K.		

Other Notes/Comments, Company Specific Procedures

Appendix 7

Sample System Operations Procedure (SOP)

Gas System Operations Procedure (SOP)

1. Purpose

The purpose of this Policy is to provide a uniform method of preparing, processing and implementing System Operating Procedures (SOP's), including notifications for performing shutdowns or tie-ins on gas transmission or distribution mains.

This Policy applies to non-emergency planned construction or maintenance requiring the shutdown or interruption of the gas transmission or distribution system; all gas main tie-ins and main extensions; as well as all service connections requiring a full tee tie-in. Non-emergency planned work is defined as work with sufficient time to allow an SOP to be written and reviewed in preparation of the work.

In addition an SOP should be utilized when work is proposed to be done that does not fall under the normal requirements for an SOP, but where the nature of work makes it prudent to pre-plan for the risk involved.

2. Responsibilities

Gas Control shall be responsible for:

- Review and approve all gas System Operating Procedures (SOP's).
- Approve all main valve operations on the gas system associated with the SOP's, other than curb cocks or meter sets.
- Assist in the review of SOP's with Instrumentation & Regulation (I&R), Project Engineering & Design, Gas Operations Engineering, Gas Field Operations and Construction and LNG/Propane Air as required.
- Notify I&R when construction is located within 200 feet of regulator stations, gate/take stations, gas plants, gas holders and/or compressor facilities. Electronic SOP's shall be sent to I&R for review when critical facilities are identified, prior to Gas Control review.
- Coordinate with I&R as required when taking regulators stations out of service.
- Ensure the most recent version of the SOP is at the field location – verify the SOP number and revision number.
- Updating in-progress SOP's with completed steps/details communicated from field representatives, including but not limited to pressure readings, valve operations, flow testing, pipe joining, etc.
- Place the appropriate status of the job in the SOP system as communicated by the field organization performing the work.
- Produce a report on a regular basis, as a recurring task on the calendar, showing open SOP's, obtain current status with the field and update the SOP status as necessary.

Gas Instrumentation & Regulation (I&R) shall be responsible for:

- Review and approve all SOP's which involve gate stations, regulator stations, system interconnect valves, gas plants, compressors, supplemental odorization assessment/ injection or where the construction is located within 200 feet of these facilities.
- Generate final SOP's when I&R work requires an SOP
- Operate and tag regulator station valves and/or system valves as directed by Gas Control during the SOP including shutdowns and restoration

- Review final approved SOPs with I&R crews prior to the execution of the SOP
- Ensure the most recent version of the SOP is at the field location by verifying the SOP number and the revision number with Gas Control when ready to begin work.
- Ensure that SOP steps are followed sequentially per the final approved SOP revision
- Ensure that any changes to the SOP, or sequence changes within the SOP are reviewed and approved by Gas Control prior to their execution.
- Coordinate with Gas Control, as required, when taking regulators stations out of service.

<u>Project Engineering and Design (PE&D)</u> shall be responsible for:

- Support procedure development for inclusion in SOP's for major capital projects - designed by Gas Engineering.
- Assist in SOP development by providing key elements needed for the SOP in major capital projects designed by PE&D and forwarded for review and comment to:
  - I&R
  - Gas Field Operations and Construction
  - Gas Control
- Assist personnel writing final SOP, as requested.

<u>Gas Operations Engineering</u> shall be responsible for:

- Provide minimum operating pressure, temperature and by-pass (jumper) sizing (if required) analyses for SOP's in which the proposed main connection would involve the disruption of gas flow or involvement of a Transmission Main.
- Review and approve SOP's to ensure system continuity.
- Support Gas Field Operations and Construction in the development and review of SOP's for gas system maintenance or expansion work as required.

<u>Field Operations / Construction / Distribution Support (as appropriate)</u> shall be responsible for:

- Develop all SOP's for shutdown or interruption of the gas transmission and distribution systems including but not limited to
  - All live gas main connections for gas main tie-ins
  - Main extensions
  - Service connections that require a full tee tie-in
- Ensure an SOP is approved prior to the start of field excavation, including pipe installation in accordance with ***your company's procedures***
- Review final approved SOP with responsible party overseeing the execution of the work-prior to beginning in the field.

- Prior to executing the SOP, contact Gas Control and request permission to proceed with work in accordance with instruction set forth within.
- Ensure the most recent version of the SOP is at the field location – verify the SOP number and the revision number with Gas Control when ready to begin work.
- Operate and tag system valves as directed by Gas Control during the SOP - including shutdowns and restoration.
- Ensure that any changes to the SOP, or sequence changes within the SOP are reviewed and approved by Gas Control prior to their execution.
- Print a hard copy of the completed SOP, with all GSO notations, and include as part of the Historical Document Package.
- Prepare and perform a final review of Field Historical Documents and submit to Mapping in a timely fashion to update the Mapping System based on actual field as-built drawings.

<u>Gas System Mapping is responsible for:</u>

- Mark the mapping systems in the area of work with the three mapping SOP job statuses' of: “Approved”, “Complete”, and Quality Controlled (“QC'd”)
    - Approved - plot on the system maps the preliminary job after approval by Gas Control.
    - Complete - update system maps to reflect a Gassed-In Status, after completion of the SOP.
    - QC'd - perform a final review of Field Historical Documents and coordinate the updating of the Mapping Systems based on actual field as built drawings.

3. Personal & Process Safety

<u>Personal Safety</u>

All required Personal Protective Equipment (PPE) shall be worn and utilized in accordance with the current National Grid Safety Policy.

<u>Process Safety</u>

If actual work is not scheduled within 90 days of the approved SOP then a follow up review is required prior to commencing work to confirm system changes have not occurred.

Special attention needs to be taken regarding gauging requirements and more importantly the monitoring of gauges during the SOP process.

Personnel must remain aware at all times that conditions may change resulting from changing or abnormal conditions.

Accountability for correctly performing an SOP operation is assigned to the field project manager or responsible person on site.

4. Content

5.1 Administrative Control

a. <u>Technical Training</u>

1) Only technically qualified personnel will be permitted to work within the SOP Process.
2) The method of qualifying is accomplishing by the following:
   - **i.** Successful completion of the "E-Learning Training Module(s)" on SOP System Overview and how to write SOPs – **and**
   - **ii.** Attend a Two Day Overview session at the Corporate Training Center related to properties of Natural Gas and Basic Field Construction Techniques **or**
   - **iii.** Participate in the Operator Qualification Programs for Field Operations and Construction

b. <u>Written Approval</u>

1) Area Managers are required to formally request access to either approve and/or write SOPs for employees under their jurisdiction
2) This Manager will need to attest to the employees qualifications via written document

c. <u>Maintaining Technical Qualifications</u>

Working within the SOP Process - Personnel are required to write SOP periodically at intervals not to exceed 12 months or they will need to re-qualify as per Technical Training and Written Approval above.

5.2 Environmental Considerations

a. <u>Gas Venting</u>

The Company has established a goal to minimize greenhouse gas emissions by minimizing gas vented to the atmosphere during line de-pressurization and purging operations.

1) Gas should be recovered rather than vented when ever possible by de-pressurizing, through a properly designed and approved connection, into a lower pressure system where practical.
2) The SOP shall consider engineering controls to minimize gas venting.
3) Where gas venting is avoided, document estimated volume of gas recovered. I
4) If gas is vented, estimate the volume vented and document appropriately. T

b. <u>Sampling</u>

Environmental sampling (PCB Wipe Test) shall be conducted as required by applicable corporate procedure.

5.3 SOP Requirements

When an emergency shutdown (unplanned) is required as the result of a gas leak, third party damage or other unforeseen circumstance, an SOP is not required. Gas Control shall direct all shutdown operations involved with the unplanned emergency.

SOP's shall be created utilizing an electronic form.

System pressures shall be monitored with pressure gauges at the location of the shut down. During a shut down process, field crews are required take action to prevent the pressures from falling below the minimum shutdown pressure. If gas system pressures on either side of the shutdown area fall below the minimums specified in the SOP - Notify Gas Control immediately.

a. <u>Sectionalizing Valves:</u>

When designing jobs and developing SOP requests when a new gas main is installed across a boundary of a sectionalizing district, ensure that installation of a strategically located valve is included to ensure the integrity on the Sectionalizing District is maintained.

b. <u>Value Position Verification:</u>

When writing an SOP, include steps to verify the position of valves prior to the purging or gas-in operation.

c. <u>Odorant Injection (Pickling):</u>

Pickling shall be conducted as required by applicable corporate procedures.

5.4 Critical Operations

a. Critical operations performed during an SOP are defined as actions that cause gas flow interruption or re-direction of gas flow through an established bypass.

b. Critical operations shall require a Company Supervisor/Field Construction Coordinator (FCC) or competent SOP trained individual as determined by the Supervisor/FCC to be on-site during the execution of the SOP.

c. The following operations shall be considered critical:

1) Hot-taps and/or Flow interruptions are to be performed on critical mains as highlighted on the corporate mapping systems.
2) Any work within 200 feet of a district regulator or take station.
3) Low Pressure flow test and/or bypass.
4) Hot tapping and stopping as a single operation through the use of welded pressure control fittings.
5) High-pressure plastic squeeze off when bypasses are used.
6) Turning of system valves for flow interruptions or abandonment of main.

Once operations have been executed, the presence of the Company Representative is discretionary provided there are no abnormal or emergency conditions present.

5.5 Notifications

a. New SOP's or revisions to SOP's shall be submitted to Gas Control for review and approval at least 48 hours in advance of the scheduled time of the SOP.

b. **Critical Facilities**: Gas Control shall be notified at least 48 hours prior to the start of the SOP when working near Gate Stations, Transmission Mains, Regulator Stations, Power Plants, Large Industrial Customers, LNG Plant, etc.

c. **Mobilization**: The field crew performing the excavation shall notify Gas Control on the same day, prior to beginning excavation.

d. **Flow Interruption**: Gas Control shall be notified prior to interruption of gas flow, to "Request Permission" to start the shutdowns or tie-in operations, and from then on at the direction of Gas Control.

Gas Control shall request the radio number and/or Nextel number of the crew(s) performing the work. Communications tests shall be coordinated/conducted as needed.

e. **SOP Implementation**: Gas Control shall be notified at additional points during the execution of the SOP such as:

1) Prior to gassing in the new main.
2) When the first service is tied over onto the new main.
3) When last service is transferred – Prior to retirement of old main.
4) When the old main is retired and the SOP is completed.

f. Approved SOP's that have not been executed within 12 calendar months from the date originally approved shall be returned to author for review. If the work is still required, a revised SOP shall be initiated.

If an SOP is discontinued prior to the completion of the work and scheduled to re-start at a later date, the Field Supervisor responsible for successful completion of the SOP shall notify Gas Control of a "Temporary Stop" and estimated date of when work is to start again. Field Supervision shall confirm the interim disposition of all work including an estimated continuation/completion date with Gas Control which will be noted in the next step in the Gas Control comment section. Field Operations shall confirm with Gas Control that both field conditions and system operating conditions have not changed to the extent the original SOP is invalid.

If an SOP is cancelled, Gas Control shall be notified in order to update the outstanding SOP files.

5.6 Gauging Requirements

All procedures require the installation of "*Sufficient Gauges*" to ensure the integrity of the system regardless of system pressure (i.e. low, intermediate, and high pressure).

a. Gauges shall be installed on all operating systems that may be impacted by the work.
b. Gauges shall be installed for tapping operations, bag-off operations, valve operations or any stoppage of gas flow.
c. Gauges shall be installed on both sides of any live gas work area.
d. Pressure gauge readings shall be called into Gas Control at the end of each stoppage of gas flow operation – include the pressure before the stoppage of flow.
e. Gauges shall be monitored for flow interruptions - throughout the scope of work
f. Gauge pressure readings shall be documented and included in the field package.

Once the live gas operation commences and the system stabilizes, crews shall monitor the pressure for an additional 15 minutes (minimum) to ensure the system can handle the stoppage of flow, and then "*Request Permission*" from Gas Control before proceeding with the next steps in the SOP. Gauges shall be continually monitored throughout the scope of the work.

5.7 Bypass Operations

The installation of bypasses is required on jobs - determined by the SOP author, Gas Operations Engineering or Gas Control.

a. Gas Operations Engineering will determine the size and number of bypasses required.
b. Flow stoppage will be monitored with sufficient gauges outside the work area and minimum gas system pressure requirements will be maintained. Call in pressure readings to Gas Control.
c. Low Pressure (LP) bypasses shall be flow tested. A flow test will confirm if the recommended bypass is sufficient.

If the bypasses do not support system pressure - notify Gas Control and proceed to install additional bypasses.

Notify Gas Control if the additional bypasses support system pressure - if not the job will be stopped until further investigation is complete with the input from Gas Operations Engineering.

On Low Pressure Mains; if bypasses are not used, a flow test or pressure recovery test is required in accordance with the applicable procedure (e.g., Standard Flow test procedure for main bag-off low pressure main or equivalent).

On elevated pressure mains; if bypasses are not used, a pressure recovery test is not required, but is recommended based on regional practice. Gauge requirements still apply.

5.8 Flow Stoppage Without Bypass

In order to stop flow of gas without the use of a bypass, the pressures on both sides of flow stoppage shall be monitored by the installation of sufficient gauges.

a. Prior to the stoppage of flow, closing of a valve, bagging etc, gauges shall be checked and minimum system pressures shall be ensured before SOP proceeds.
b. Once the live gas operation commences and the system stabilizes, crews shall monitor the pressure for an additional 15 minutes (minimum) or longer if noted on SOP to ensure the system can handle the stoppage of flow, and then request permission from Gas Control before proceeding with the next steps in the SOP. Gauges shall be continually monitored throughout the scope of the work.

5.9 Flow Test

a. Upon stopping the flow of gas with the use of a flow test, the pressures on both sides of the flow stoppage shall be monitored by the installation of sufficient gauges in accordance with appropriate procedures (e.g., Standard Flow test procedure).
b. Gauges shall be utilized prior to the stoppage of flow.
c. Closing a valve, bagging, etc; both sides of work area shall be monitored and minimum system requirements shall be maintained.
d. Pressure readings shall be called into Gas Control.

If the Flow Test fails, notify Gas Control and commence bypass operation in accordance with the (e.g., Standard Flow test procedure).

5.10 Valve Tagging Requirements

a. Prior to operating permanently installed system valves as part of an SOP, permission shall be obtained from Gas Control. If valves are operated as part of an SOP, a “Do Not Operate Tag” shall be attached to prevent inadvertent operation and to protect the safety of personnel and the integrity of the job.
b. When developing SOP’s, all organizations are to evaluate the process to determine if system valves shall be operated

5.11 Valve Tagging Process

a. When GAS CONTROL directs the authorized employee to operate a valve, a “Do Not Operate Tag” is required and that employee shall record on the tag the required information: Refer to Sample Valve Tag (Attachment 1: Sample Valve Tag)
b. The authorized employee or Field Supervisor shall be responsible to remove Tags as directed by Gas Control as outlined in the SOP. Authorized employees removing the tag do not have to be the same employee who attached the tag. This tag shall be kept on file along with other project documents.

No tag shall be removed without direction from Gas Control

When non-company personnel are performing work, an authorized Company employee is responsible to call in all the steps of the SOP to Gas Control and to direct the attachment of the tag when authorized by Gas Control.

c. Only under the direct supervision of a Company employee shall Non-Company personnel be permitted to apply/remove tags

d. Valves installed during construction, and left in the closed position, also require the installation of a “Do Not Operate Tag” and permission to operate prior to the main being gassed in. Valves left in open position do not require tagging.

e. Return the tags and file it along with other associated project documents.

5.12 Guidelines for Taking a regulator Out of Service

a. Outage Authorization:

1) Prior to taking the station out-of-service:

i. Gas Control Operator - verify station outage temperatures and current restrictions on the system.

ii. I&R - notify and receive permission from Gas Control

Refer to the Gas Operations Engineering Temperature Restriction Chart to determine the minimum outage temperature. For issues relating to the span between current temperature verses chart temperature, contact Gas Operations Engineering for verification. For areas that do not have a Gas Operations Engineering Temperature Restriction Chart and the work is planned, the I&R Supervisor and Gas Control shall have obtained through Gas Operations Engineering, a station outage analysis that contains the associated restrictions determined by that analysis. If the shutdown is an emergency, Gas Control shall initiate contact with Gas Operations Engineering, who shall then run a station outage analysis.

Review current system outage work on the gas system in the area. If a current system outage exists, contact Gas Operations Engineering to perform a revised station outage analysis.

b. Regulator Station Outage and Monitoring:

The station outlet pressure shall be monitored by Gas Control via SCADA (where applicable) and by the on-site I&R Crew using a calibrated gauge. The pressure shall be monitored for a minimum period of 15 minutes following stabilization of pressure to ensure that the system can handle the regulator station shutdown.

1) Prior to isolation of the regulating station:

i. I&R Crew -setup and monitor the station outlet pressure using a calibrated gauge that best matches the pressure range to be monitored.

ii. I&R - notify Gas Control of the current outlet pressure prior to lowering the station’s outlet pressure.

iii. Gas Control - verify reading against SCADA outlet pressure of that station, where available.

c. Outlet Pressure Stabilization:

1) I&R crew - lower the set point of the controlling regulator (2nd stage where applicable) to shut the station flow down while monitoring the outlet pressure until it stabilizes.

Do not let the outlet pressure drop below the applicable pressure restriction set by the Gas Control Operator.

2) I&R crew - close the inlet valve to the controlling regulator (2nd stage where applicable), and any associated control line valves per the applicable sequence based on the operating characteristics of the installed regulators. Parallel run stations shall have both runs valved off including the associated control lines.
   i. Gas Control - record valve/s #'s (where applicable).
3) I&R crew - If the pressure holds above the applicable pressure restriction and it is stable, record the stabilized outlet pressure and communicate it to Gas Control.
   i. Gas Control -record the time and outlet pressure reading from field and if applicable, the SCADA outlet pressure reading.

If the pressure does not hold above the applicable pressure restriction or it is not stable, the station can not be shut down and the outlet pressure shall be restored to its starting value.

   ii. I&R crew - notify Gas Control and the appropriate I&R Supervisor that the station can not be shut down.

d. Station Isolation:

I&R Crew - ensure that at all times the station outlet pressure is being monitored by a gauge and that they are not looking at a trapped gas pressure due to the closing of any valve.

1) Gas Control - record time of main valve/s closure/s.
2) For stations with SCADA outlet pressure monitoring:

I&R Crew - ensure that at all times, the station outlet pressure transmitter is not locked in by any closed valve and the station shall be left in a state such that Gas Control can continuously monitor the station system outlet pressure.

3) Stations being taken out of service for extensive work either at the station or out in the system that makes SCADA monitoring of the station impracticable, may have the SCADA pressure transmitters taken out of service after the minimum 15 minute monitoring period.
4) Proceed to monitor the station outlet pressure for minimum of 15 minutes.

e. Outlet Pressure Monitoring 15 Minute Minimum:

1) I&R Crew - monitor the station outlet pressure for a minimum of 15 minutes and contact Gas Control with ending reading.
2) Gas Control - record the time and outlet pressure reading from field and if applicable, the SCADA outlet pressure reading.

The station outlet pressure should not drop below the recorded stabilization pressure. If at any time during this minimum 15 minute monitoring period, the station outlet pressure drops or it becomes unstable, the station shall be turned back on and set to the initial outlet pressure setting.

3) If the outlet pressure does not stabilize or drops during the minimum 15 minute monitoring period:
   i. I&R crew - remain on-site and complete the work at the station immediately.

ii. If the station is being taken out of service for work out in the system, that work can not proceed until the source of the problem is found.

iii. Gas Control - notify both the I&R manager and the respective field maintain manager

5.13 Pressure Schematic Upgrade notification

a. In the SOP application there is a Y/N Checkbox to indicate whether the SOP work requires an update to the Corporate Pressure Schematic.

b. Reasons for triggering a schematic upgrade include:

1) Regulator Station addition
2) Regulator Station retirement
3) Change to system MAOP on inlet to regulator station (new supply or system uprate/derate)
4) Change to system MAOP on outlet of regulator station (system uprate/derate/integrate)
5) Connect single feed system to another system at same MAOP
6) Addition of a Source Point (pipeline, LNG, biogas, CNG, etc.) *Retirement of a Source Point (pipeline, LNG, biogas, CNG, etc.)
7) Change to MAOP of a Source Point
8) Connect systems with multiple feeds to other systems with multiple feeds

c. SOP writers and reviewers have the option of checking yes or no throughout the SOP process.

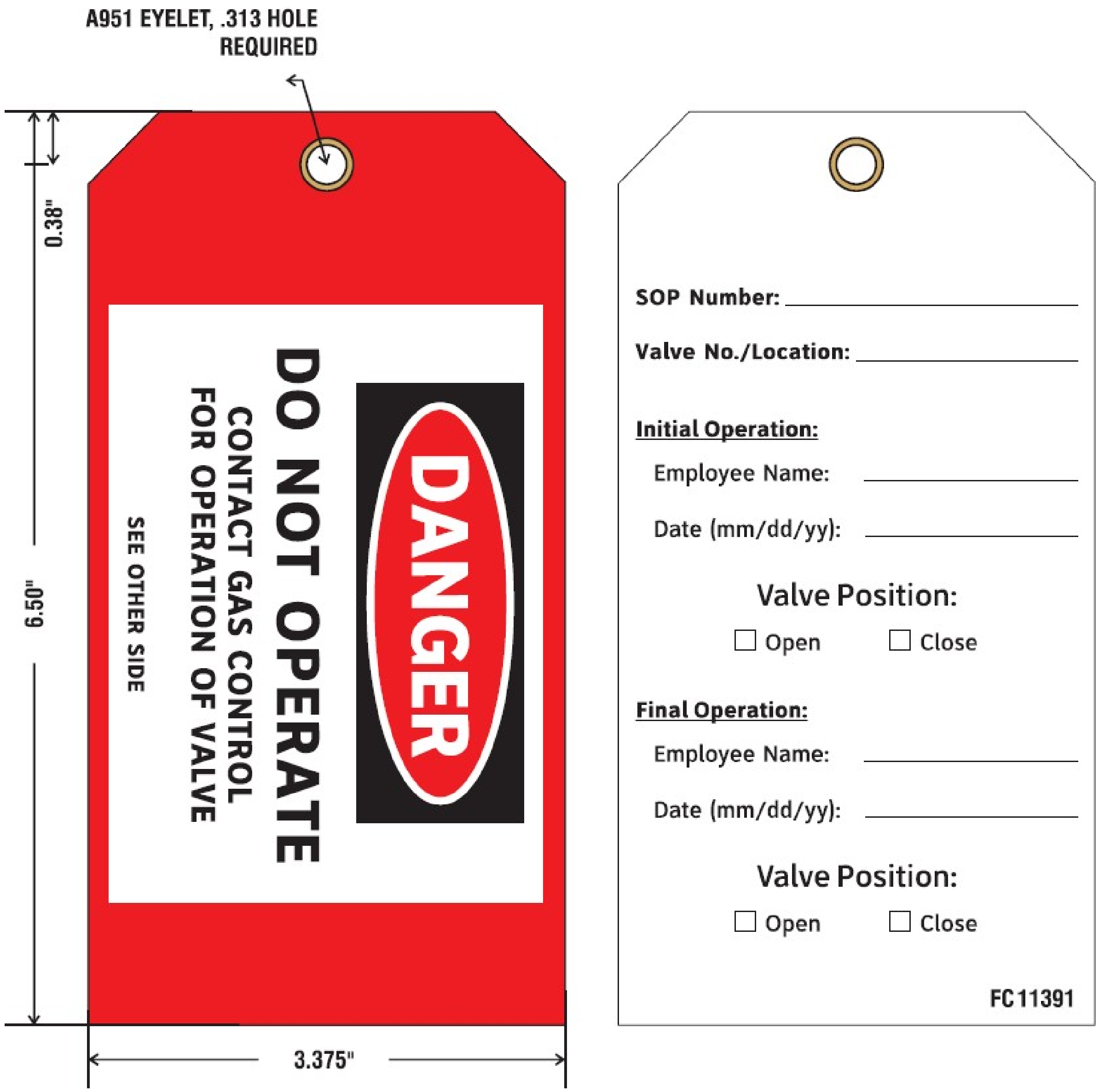
1) Upon Completion of the SOP, an email will be triggered by the SOP to the Pressure Schematic Review Team.
2) If a schematic update is needed, members will update the pressure schematic and store on the records server.

6. Attachments

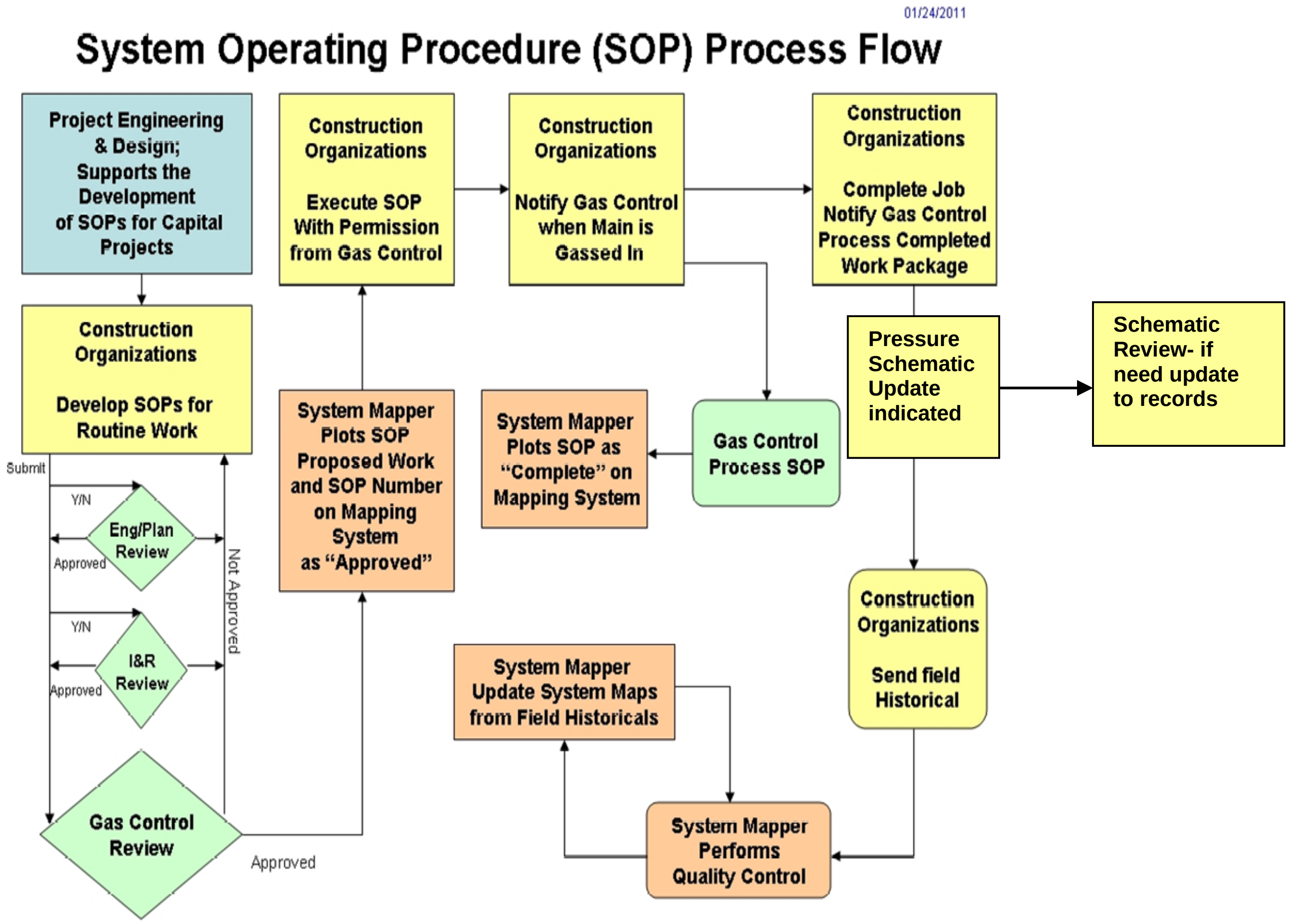
Attachment 1: Sample Valve Tag

Attachment 2: System Operating Procedure - SOP Process Flow Chart

Attachment 1: Sample Valve Tag



Attachment 2: System Operating Procedure - SOP Process Flow Chart



Appendix 8

Sample Pre-Startup Safety Review Checklist

SAMPLE Pre Start-up Safety Review (PSSR) Procedure

INTRODUCTION

A Pre Start-Up Safety Review (PSSR) examines a new or modified process safety asset to ensure that it has been constructed as per the approved design, that all safeguards and protective devices have been calibrated and tested and that it is safe to operate as per the details contained in this procedure. The requirement for a PSSR also applies to assets that have been out of service for an extended period as a result of repair or temporary discontinuation of use.

The requirement to perform a PSSR is part a Process Safety Management System (PSMS) and a corresponding approach to assess major hazards. In this context, major hazard is defined as an incident that leads to the loss of control in the operation of an asset resulting in significant loss of containment of a dangerous substance leading to serious danger to people or the environment onsite or offsite.

This procedure applies to Company defined Major Hazard assets, including:

- Compressed Natural Gas (CNG);
- Gas Transmission and facilities operating at 125 psig and above;
- Power Generation;
- Liquefied Natural Gas (LNG);
- LNG Trucking.

However, this procedure can also be broadly applied to the management and operation of other Comapny non major hazard assets, including ***Gas Distribution Regulator Stations.***

PURPOSE

This procedure defines the minimum standards to be adopted across Company assets for Operational Readiness by setting requirements to ensure that there is a systematic process to verify that assets are in a safe condition and that personnel are appropriately prepared before start-up of new assets or before returning assets to normal operation following a prolonged outage, or modification where the process safety information of the asset has changed.

ACCOUNTABILITY

The Corporate Process Safety Department is accountable for maintaining this procedure.

TRAINING

PSSR is a Process Safety competency. Each involved business is responsible for identifying its process safety roles and the level of competency required for each role in order to successfully implement the PSSR program for their areas in compliance.

Business Areas are responsible to ensure their employees are trained on this corporate procedure and any additional business specific guidance in order to implement this procedure.

Table of Contents

1 OVERVIEW

A PSSR determines that process safety assets are ready to be safely placed into service. PSSR evaluates not only the condition of the asset after construction, but also evaluates the asset from an operational, maintenance and emergency procedural perspective in the form of checking for written procedures and personnel training before the asset is placed into service. These evaluations ensure that instructions address safe operating issues, and that personnel are trained on its safe operation and are aware of any associated process safety hazards.

PSSR applies to new process safety assets, and to existing ones that have been modified so that the asset's Process Safety Information (PSI) has changed. A PSSR performed on a modified unit ensures that the modifications have not introduced any unforeseen hazards into its operation, that all safety issues have been incorporated in its operating instructions, that all personnel have been trained in any new or modified procedures, and that they are aware of the changes and potential new risks.

Finally, PSSR is also applied to assets that have been out of service for an extended period of time such that the integrity of the asset may have been compromised or it is not certain that all operational and safety equipment is fit for purpose. After an extensive downtime, the asset must be reviewed to ensure that it is in a safe operating condition, and that the personnel responsible for the asset are refreshed on its safe operation.

2 DEFINITIONS

Consequences – The result of the hazard scenario. Consequences of concern are process safety issues, large scale environmental events, property or equipment damage affecting use or long-term reliability, and physical injury to employees, contractors and the public.

Hazard Scenario – A specific, unplanned event or sequence of events that cause an undesirable consequence to safety or to the environment.

Likelihood – The qualitative probability of the hazard scenario occurring, given the safeguards that are currently in place. Current performance of safeguards and Probability of Failure on Demand are taken into account.

Management of Change (MOC) – Process to ensure that the changes in design or scope after a PHA is completed are analyzed from a risk perspective to incorporate any impact to risks or hazard scenarios.

Operational Readiness – Ensuring that new commissioning of assets and shutdown of assets and processes are in safe conditions to be started / restarted through types of Pre Start-up Safety Reviews (PSSR) which factors in any work performed while the equipment was shut down.

PSSR Business Lead – The individual knowledgeable with the design requirements of the new asset or modification of the existing asset, to ensure it has been constructed or modified per the approved design and is safe to operate.

PSSR Coordinator – The PSSR Coordinator is the individual responsible for coordinating PSSR activities for a given facility or business. The PSSR Coordinator reviews the PSSR Checklists to ensure that they are filled in with the desired quality of information, and for collating information to measure, track and manage the execution of the PSSR process.

Process Hazard Analysis (PHA) – Organized effort to *identify* and *analyze* the significance of hazardous situations associated with a process or activity to aid management in making critical safety decisions (also known as HIRA – Hazard Identification, Risk and Analysis).

Process Safety Information (PSI) – Information on the hazards of flammable, combustible, or toxic substances used or produced by the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process.

Risk – A measure of injury or environmental damage in terms of both the likelihood and severity of the hazard scenario.

Risk Ranking – The product of severity and likelihood used to evaluate risk.

Severity – Severity is the worst case consequence of the particular hazard scenario and assumes that safeguards have failed.

Shall – Indicates a mandatory requirement.

Should – Indicates a best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment shall be completed to show that the alternative method delivers the same or better level of protection and results.

Toxic Material – Any item or agent (biological, chemical, radiological, or physical), which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.

3 PROCEDURE

3.1 Preview and Practical Advice for performing a PSSR

3.1.1 Each facility or business shall have a systematic process for checking operational readiness and the integrity of systems before they are brought into service.

3.1.1.1 The minimum requirements for this process shall include:

- Construction and equipment shall be verified to be in accordance with design specifications for new or modified facilities;
- Process control, emergency shutdown and safety systems shall have been tested and found to be functioning as designed;
- Equipment shall be properly appropriately isolated from other systems not yet ready for start-up;
- Equipment shall be properly maintained, checked and be ready for service;
- Equipment and equipment configuration including valve positions shall have been verified to be released to operations and ready for start-up;
- Adequate safety, operating, maintenance and emergency procedures are in place and training of employees involved in these activities shall have been completed prior to putting the assets into service;
- Start-up decisions shall be based on the results of readiness evaluations rather than operational and economic pressures;
- Checks and verification shall be carried out by competent personnel and recorded by the business as part of the PSSR;
- Businesses shall have a defined criterion for categorizing and handling identified issues and outstanding work items;
- Completed checks and verifications shall be reviewed, approved and accepted by specific levels of management defined by the business as appropriate to the magnitude of risk.

3.1.2 A PSSR shall be performed before the start-up of a new or significantly modified facility is authorized.

3.1.3 The individual responsible for the operation of the new facility or modification shall use the following logic to determine when a PSSR is required:

3.1.3.1 A PSSR **IS** required if the modifications to a facility are significant enough to require a change in the asset's Process Safety Information (PSI).

3.1.3.2 A PSSR **IS NOT** required for facilities that have been modified so slightly that process safety information (PSI) does not change.

3.1.4 For any modified assets or facilities, the **Management of Change (MOC) Procedure [PS-02-02]** requirements must be satisfied before start-up.

3.1.4.1 The MOC requirements do not take the place of or eliminate the PSSR.

3.1.5 For new assets or facilities, a Process Hazard Analysis (PHA) must be performed as part of the design phase before start-up and in accordance with the **Process Hazard Analysis (PHA) Procedure [PS-00-01]**.

3.1.5.1 The PHA does not take the place of or eliminate the PSSR.

3.1.5.2 The PSSR team must verify that all of the PHA recommendations required before start-up have been implemented or resolved before the facility can be judged safe to operate.

3.1.6 An appropriate PSSR Checklist shall be used based on the type of construction, maintenance or outage work recently performed.

3.1.7 Reviews should be commensurate with the complexity and level of risk introduced by the new asset or modification.

3.1.8 The PSSR Business Lead will evaluate the extent of the modification or new facility and determine the appropriate PSSR approach to use.

3.2 Completing the PSSR Checklist

3.2.1 The PSSR Business Lead shall identify the need for a PSSR.

3.2.2 The PSSR Business Lead shall determine the appropriate PSSR Checklist to use.

3.2.3 The PSSR team shall perform a physical review of the asset or facility just before start-up to confirm that all related requirements have been met before the process is initiated.

3.2.4 The PSSR team shall identify issues which shall be corrected **BEFORE** start-up and issues which can be corrected **AFTER** start-up.

3.2.4.1 Decisions for categorizing which issues shall be corrected either before or after start-up should be based upon the following logic.

3.2.4.1.1 Issues that shall be resolved BEFORE start-up:

- Deficiencies that could cause or result in a major accident (one that leads to the loss of control in the operation of an asset resulting in significant loss of containment of a dangerous substance leading to serious danger to people or the environment onsite or offsite).

- The process cannot be safely started or operated until these issues are corrected.

3.2.4.1.2 Issues that can be resolved AFTER start-up:

- Issues that do not affect the safe start-up or operation of a unit but that, if corrected, enhance its process safety.

3.2.5 All members of the PSSR team shall review and sign the PSSR form to confirm the asset or facility is safe for start-up.

3.2.6 A Manager (or higher) in the business that operates the asset shall do the final sign off only after all Category A action items are completed. This indicates that it is safe for start-up.

3.2.7 Submit the completed PSSR Checklist (including checks and verifications) to the asset owner and obtain approval by Manager (or higher) to start-up the asset.

3.3 Develop Action Item List

3.3.1 The action item list should be reviewed when the PSSR has been completed.

3.3.1.1 Action Items shall be (a) clearly documented, (b) assigned to a specific individual who is capable of addressing them.

3.3.1.2 The PSSR Business Lead shall assign an individual owner as well as appropriate resources and a target completion date for all Action Items coming from the PSSR.

3.3.1.3 The PSSR Business Lead is responsible to ensure the Action Items are tracked through to completion and completed on time.

3.4 Continuous Improvement

3.4.1 The businesses shall review their PSSRs to identify lessons learned and ways to improve their process.

3.4.2 Where there is common equipment, these should be shared to foster continuous improvement across the Company.

3.4.3 The business shall appoint a PSSR Coordinator to ensure proper functioning of the PSSR program.

3.4.4 The PSSR Register shall be used to track the status of all initiated safety reviews.

3.4.5 The business shall develop and monitor leading and lagging Key Performance Indicators (KPI) to monitor the effectiveness of the PSSR program.

3.5 Responsibilities

3.5.1 The PSSR procedure shall be applied by a team.

3.5.2 The PSSR team shall consist of at least two (2) people:

3.5.2.1 As many team members as necessary should be selected to ensure complete review and the safe operation of the asset.

3.5.3 A meeting should occur in which the team works in a discussion-style format to conduct the PSSR.

3.5.4 The responsibilities of the PSSR Business Lead include, but are not necessarily limited to:

- Form and organize team meetings based on the business input;
- Lead meetings in accordance with applicable ground rules (below);
- Introduce and ensure team understanding of motivation and application of procedure;
- Guide discussion during the assessment and keep team on task;
- Gather and update applicable process safety information (PSI);
- Complete, document and file results of the PSSR;
- Organize and plan field inspections as required by the complexity of the project.

3.5.5 The responsibilities of the PSSR Coordinator include, but are not necessarily limited to:

- Perform or support the role of the PSSR Business Lead for more complex reviews;
- Periodically review selected PSSR Checklists, action items and associated documentation for accuracy and completeness.

3.5.6 Applicable ground rules for the team application of this procedure:

- All suggestions and contributions carry equal weight;
- Online problem solving, designing, or redesigning should be avoided;
- One (1) person talks at a time;
- No overt attempts to influence the opinion of any other team member.

3.6 Documentation and Record Retention

3.6.1 The PSSR and associated Process Safety Information (PSI) shall be documented and retained in accordance with internal and external document retention policies and regulations.

3.6.2 The PSSR, Action Items and documentation showing how the Action Item was closed shall be stored by the PSSR Business Lead in the **Pre Start-up Safety Review (PSSR)**

folder for their business in the **Process Safety Risk Assessment Filing Cabinet** (SharePoint site) linked to the SHE website.

3.6.3 Action Items rejected shall have documentation supporting reasons why it is justifiably declined and how adequate safety is provided in an alternative measure.

3.6.4 Results of the PSSR shall be proactively communicated and made available to all involved employees and contractors by the Business Lead.

3.6.5 Records for the PSSR shall be submitted by the PSSR Business Lead to the asset owner upon completion and remain available for the life of the organization.

3.6.6 The PSSR shall be conducted using the Company approved tools.

4 REFERENCES

List Company Specific References

5 APPENDICES

5.1 Appendix A: Example Pre Start-up Safety Review (PSSR) Checklist

Pre-startup Safety Review Checklist	
Part of the Business / Region:	
Involved Equipment:	
Project Number:	

Signatures below indicate acceptance that the equipment or project is safe and satisfactory to start-up with the exceptions noted.	
Engineering	**Date**
Maintenance	**Date**
Instrumentation and Controls	**Date**
Project Management	**Date**
Operations	**Date**
PSSR Business Lead	**Date**

Checklist Item No.	**Action Item Details (reference category / item no.)**		**Action Item Owner**	**Due Date**
Category A* Action Items** – *to be completed* ***BEFORE *authorization and start-up*				
	A.1			
	A.2			
	A.3			
Category B* Action Items** – *to be completed* ***AFTER *start-up*				
	B.1			
	B.2			
	B.3			
Sign below only when all punch list "Category A" Action Items are completed				
Authorized:	*Plant / Equipment Operations Signature (Manager or higher):*		**Date**	

PSSR ITEM No.	CATEGORY / ITEM TO ASSESS	Owner	Completed (Y/N/NA)	Owner initials	Inspection Date
	1.0 GENERAL SAFETY				
1.1	Has adequate and appropriate *PPE* (Personal Protective Equipment) been specified in the Work Procedures and/or Standard Operating Procedures.	Operation			
1.2	Has the PPE been provided?	Operation			
1.3	Have the PPE users been trained in the use of the PPE?	Operation			
1.4	Are all of the applicable Work Permit Procedures (Confined Space Entry, Lock Out/Tag Out, Hot Work, etc.) for this equipment in place?	Operation			
1.5	Have the Operating, Maintenance, and Supervisory personnel been properly trained on the Work Permit Procedures?	Operation			
1.6	Has any fire protection systems been inspected and approved for use by the internal responsible party for fire protection or the external insurance company?	Proj Mgt			
1.7	Are all of the applicable Operating Permits up to-date and approved?	Proj Mgt			
1.8	Review lessons learned from previous PSSRs on similar equipment or processes	All			
	2.0 MACHINERY/EQUIPMENT SAFETY				
2.1	Has all access to dangerous moving parts, or danger zones created by the equipment, been prevented by the provision of the correct guards, interlocks (both safety & non-safety) and/or barriers?	Proj Mgt			
2.2	Is the equipment provided with a clearly identified means to securely isolate it from *ALL* energy sources?	Operation			
2.3	Has safe access been provided to the equipment that requires operator and calibration and maintenance personnel access for normal operations, adjustments, service, calibration, maintenance, or repair?	Operation			
2.4	Is the equipment provided with the properly identified *START/STOP* and *EMERGENCY* controls that are positioned for safe operation without hesitation, or loss of time, and without ambiguity?	Operation			
	3.0 PROCESS SAFETY – PROCESS TECHNOLOGY				

PSSR ITEM No.	CATEGORY / ITEM TO ASSESS	Owner	Completed (Y/N/NA)	Owner initials	Inspection Date
3.1	Are up-to-date Safety Data Sheets (SDS) available if involved?	ENGR			
3.2	Have the hazardous effects of inadvertent mixing of different materials been considered if relevant to the process?	ENGR			
3.3	Has the design basis and drawings been documented or updated to include new and changed equipment including all safety protective equipment and devices so that they can serve as as-built documentation for the PSSR? Note: this is not meant to address record management issues under RCS10.	ENGR			
3.4	Have calculations been done to determine the size and type of safety protection needed from worst case credible asset related failures?	ENGR			
3.5	Do the calculations take into account potential external fire exposures (i.e. Are relief valves sized to handle heat from external fire)?	ENGR			
3.6	Are all relief devices designed to vent to safe locations away from potential employee exposure?	ENGR			
3.7	Are there isolation valves designed that if closed, will inhibit the operation of pressure relief devices?	ENGR			
3.8	If yes, are there control plans to insure that the isolation valves cannot inhibit the operation of the pressure relief devices.	Operation			
4.0 PROCESS SAFETY – MANAGEMENT OF CHANGE (MOC)					
4.1	Has a management of change form been prepared and approved for the new design project?	ENGR			
4.2	Has a management of change form been prepared and approved for the new design project, if this is a design change to existing equipment?	ENGR			
4.3	Are all action items, arising from the MOC, that were deemed necessary for start-up, complete?	Proj Mgt			
4.4	Has a management of change form been prepared and approved for applicable construction changes to an approved design?	Proj Mgt			
5.0 PROCESS SAFETY – PROCESS HAZARDS ANALYSIS (PHA)					

PSSR ITEM No.	CATEGORY / ITEM TO ASSESS	Owner	Completed (Y/N/NA)	Owner initials	Inspection Date
5.1	Have project PHAs been approved by the Process Safety governing body?	ENGR			
5.2	Are all action items, deemed necessary from the PHA related to start-up been completed in accordance with **Process Hazard Analysis (PHA) Procedure**?	Proj Mgt			
5.3	Are all action items, deemed necessary from the LOPA related to start-up been completed in accordance with **Layer of Protection Analysis (LOPA) Procedure**? If applicable.	Proj Mgt			
5.4	Are all action items, deemed necessary from the QRA related to start-up been completed in accordance with **Quantitative Rias Assessment (QRA) Procedure**? if applicable.	Proj Mgt			
5.5	Has Facility Siting been completed for this asset in accordance with **Facility Siting Procedure**? If applicable.	Proj Mgt			
6.0 PROCESS SAFETY – QUALITY ASSURANCE					
6.1	Have checks and inspections been made to ensure that critical equipment is installed properly and is consistent with design specifications and vendor's recommendations (for example, alarm and interlock (safety & non-safety) tests; equipment alignment and service to process inter-connections)?	Proj Mgt			
6.2	Have inspection reports, covering fabrication, assembly, and installation, been completed in accordance with the project's procedures, work methods and any applicable quality assurance plans?	Proj Mgt			
6.3	Does the construction meet the design specifications and the drawings?	Proj Mgt			
6.4	**Have the following documents been provided and approved:**				
6.4.1	Instrument indexes and instrument loop diagrams?	Proj Mgt			
6.4.2	A tabulation, including settings, of interlocks (both safety & non-safety) and trips (hardwire and software), process alarms and permissive descriptions?	Proj Mgt			
6.4.3	As-built drawings covering P&IDs, electrical, piping, and mechanical?	Proj Mgt			
6.4.4	Data sheets for pressure equipment built to ASME or equivalent codes?	Proj Mgt			

PSSR ITEM No.	CATEGORY / ITEM TO ASSESS	Owner	Completed (Y/N/NA)	Owner initials	Inspection Date
6.4.5	Data sheets for over pressure protection setpoints and initial testing?	Proj Mgt			
6.4.6	Date pressure test has been complete?	Proj Mgt			
6.4.7	Welder certification?	Proj Mgt			
6.4.8	Non-destructive test (NDT) or examination (NDE) certifications?	Proj Mgt			
6.4.9	Electrical certification for classified areas?	Proj Mgt			
6.4.10	Enter additional relevant documents if needed.	Proj Mgt			
6.5	List all commissioning tests performed (for example, pressure, leak tests, meggaring, etc.)	Proj Mgt			
7.0 PROCESS SAFETY – MECHANICAL INTEGRITY					
7.1	Have maintenance procedures been developed and approved by the business?	MAINT			
7.2	Have maintenance personnel been trained in maintaining the equipment?	MAINT			
7.3	Are their adequate inventories of critical spare parts?	MAINT			
7.4	**Have inspections and tests, including regulatory requirements for the following equipment been included in a maintenance schedule:**				
7.4.1	Pressure vessels and storage tanks?	MAINT			
7.4.2	Pressure relief systems, vent systems, and devices?	MAINT			
7.4.3	Critical controls, interlocks (both safety & non-safety), alarms and instruments?	MAINT			
7.4.4	Emergency devices (including shutdown systems and isolation systems)?	MAINT			
7.4.5	Fire protection equipment?	MAINT			
7.4.6	Piping systems (incl. Components, for example, valves, excess flow valves, expansion bellows) in critical service?	MAINT			
7.4.7	Emergency alarm and communication system?	MAINT			
7.4.8	(list any other critical equipment)	MAINT			
8.0 PROCESS SAFETY – OPERATING PROCEDURES AND SAFE WORK PRACTICES					
8.1	Have standard operating procedures been prepared/updated and approved by the business?	Operation			

PSSR ITEM No.	CATEGORY / ITEM TO ASSESS	Owner	Completed (Y/N/NA)	Owner initials	Inspection Date
8.2	Do the operating procedures cover: Initial start-up? Normal start-up? Normal operations? Normal shutdowns? Emergency operations including emergency shutdowns? Start-up after emergency shutdowns? Start-up following turnarounds/prolonged shutdowns? High hazard non routine operations?	Operation			
8.3	Have Operations been trained in operating procedures?	Operation			
9.0 PROCESS SAFETY – TRAINING AND PERFORMANCE					
9.1	Has specific process (or job task) training been given to Operations personnel?	Operation			
9.2	Have training records been updated?	Operation			
10.0 PROCESS SAFETY – CONTRACTOR SAFETY					
10.1	Have contract personnel been adequately trained in applicable awareness, maintenance, and evacuation procedures?	Operation			
11.0 PROCESS SAFETY – PROTECTIVE DEVICES: INTERLOCKS, ALARMS and SIS					
11.1	Did design require a Safety Instrumented System (SIS) in accordance with ANSI / ISA 84? If yes, was the SIS completed in accordance with internal SHE procedures and Risk Control Standards?	ENGR			
11.2	Did the loop testing confirm that the alarm/interlock (safety & non-safety) action proved, under all conceivable failure conditions, to be fail-safe and performed as per design?	ENGR			
11.3	Has an interlock/critical alarm procedure for testing, through to the final element, been prepared and reviewed/authorized by a competent person for each new or upgraded control system?	ENGR			
11.4	Has the equipment software in the field been verified (for example, logic drawings, schematics, sequence/batch descriptions) to ensure that it is the version specified in the design?	ENGR			
11.5	Have alarms been rationalized?	ENGR			
11.6	Have alarm response sheets been completed?	ENGR			

PSSR ITEM No.	CATEGORY / ITEM TO ASSESS	Owner	Completed (Y/N/NA)	Owner initials	Inspection Date
11.7	Do you have an appropriate procedure to ensure that your software is protected (for example, routinely archived, key/password protected, etc.)?	ENGR			
11.8	Has all software been properly validated and tested?	ENGR			
11.9	Have all process and safety alarms and shutdowns been set and tested to be in accordance with Engineering design?	Proj Mgt			
11.10	Have all SIS equipment been added into inspection and maintenance plans?	MAINT			
11.11	Have all SIS equipment been added to the asset risk register?	MAINT			
11.12	Have all protective devices been added to the protective device asset register.	MAINT			
11.13	Have all protective and SIS devices been added to the inspection, testing and maintenance workplans.	MAINT			
12.0 PROCESS SAFETY – EMERGENCY ARRANGEMENTS					
12.1	Have Emergency Procedures been prepared and relevant personnel trained?	Operation			
12.2	Are Emergency Evacuation plans available with key roles identified and drill completed to validate functionality of plan and assembly plan?	Operation			
12.3	Is emergency lighting adequate?	Operation			
12.4	Is sufficient Respiratory Protective Equipment, such as Escape Sets or Self-Contained Breathing Apparatus (SCBA) required and if so available with personnel certified and trained in its usage?	Operation			
12.5	Are relevant key external stakeholders aware of project?	Operation			
13.0 PROCESS SAFETY – FIELD VERIFICATION					
13.1	Are all pipelines labeled?	Proj Mgt			
13.2	Are all electrical switches, disconnects, MCCs, control panels, cables labeled?	Proj Mgt			
13.3	Are electrical conduits sealed in accordance with code requirements?	Proj Mgt			
13.4	Are wall penetrations adequately sealed?	Proj Mgt			
13.5	Has all scaffolding and construction equipment been removed?	Proj Mgt			
13.6	Is housekeeping acceptable to allow a start-up?	Proj Mgt			

PSSR ITEM No.	CATEGORY / ITEM TO ASSESS	Owner	Completed (Y/N/NA)	Owner initials	Inspection Date
13.7	Equipment and equipment configuration including valve positions shall have been verified to be released to operations and ready for start-up	Proj Mgt			
13.8	Does initial startup of asset include a named individual responsible for periodically checking performance of asset for first 48 hours? Insert individual's name here:	Operation			
14.0 PROCESS SAFETY – HUMAN FACTORS					
14.1	Have a new safety critical activity (SCA) procedure been developed?	ENGR			
14.2	Have the new SCA procedure been categorized in accordance with **Safety Critical Activity Procedure Categorization and Risk Ranking Tool**?	ENGR			
14.3	Have the new SCA procedure been assessed for Human Errors in accordance with either of the following: **Four-Question Analysis Procedure, Hierarchical Task Analysis (HTA) Procedure, Eight Guideword Analysis Procedure**?	ENGR			
14.4	Was a Human Factors Basis of Design (BOD) completed for this asset in accordance with **Safety in Design Specification for Incorporating Human Factors**?	ENGR			

Appendix 9

Sample Change Control Procedure for Construction Projects

Change Control Procedure for Construction Projects

1. Purpose

This procedure sets out the administrative requirements, responsibilities and approval process for field changes to construction projects to account for budget, schedule and scope changes.

a. The objective of this procedure is to ensure that:
   1. Significant changes in scope to construction projects receive appropriate review and approval prior to being implemented. These include but are not limited to changes resulting from:
      a. Field Conditions
      b. Scope Change
      c. Design Change
      d. Personal and Process Safety Issues
   2. Construction project changes are identified, recorded and approved. The Change Control Procedure is implemented from the time a change is identified through implementation of the change.

b. This procedure applies to the following projects:
   1. All Managed Projects (Including Complex Design Projects)
      i. Complex Design Projects Category 3 changes prior to issuance of construction drawings.
      ii. Complex Design Projects after construction drawings have been issued: As specified in section 5.1
   2. All standard Projects (Non-complex Design Projects) with estimates exceeding $100,000

Exceptions to this procedure to accommodate business or operational needs shall be approved by the Engineering Executive with responsibility for the Construction Process and documented on the Project Change Order Form (Attachment 1)

This procedure does not cover changes to the approved detailed gas design drawings or established gas work methods, policies and construction standards/drawings. Changes to detailed Project Engineering drawings must be referred to Project Engineering for review and approval and may require a Management of Change (MOC) in accordance with Process Safety Management of Change Protocols(Reference Section 3). Changes to Gas Work Methods, Policies and Construction Standards are governed by XXXXXX Governance Policy and must be reviewed and approved prior to field Implementation.

2. Responsibilities

Manager of Complex Construction, Project Manager or Regional Construction/Field Ops Manager or designee shall be responsible for:

- Initiating Change Orders as necessary when not initiated by others
- Ensuring approvals are obtained as necessary.
- Advising Process Director or Regional Construction Director of any impact of Change Orders on project design and schedule.

- Obtaining necessary documentation from contractors on Change Orders.
- Approving non-complex design project Category 1 and Category 2 Change Orders not approved by Engineering or Supervisor/Field Construction Coordinator.
- Submitting for approval complex design project Category 1 and Category 2 Change Orders to Project Engineering & Design as required.
- Initiating, as required, reviewing and submitting Category 3 Change Orders for review and approval to Network Strategy and Regional Construction Directors.
- Maintaining Project Change Order Forms and Change Control Log in the Work Order/Project Folder and or project electronic data base

Construction & Maintain Supervisor / Field Construction Coordinator (FCC) or designee shall be responsible for:

- Initiating Project Change Order Forms for Category 1, 2 and 3 Change Orders as necessary.
- Completing Contractor Information, Contract Information, Change Order Category, Project Accounting and Change Notification sections of Change Order Form (Attachment 1)
- Notifying the Originating Organization, Resource Planning, Gas Construction/Maintenance, Project Management/Engineer of the requested change and record on the Change Order Form
- Approving non-complex design project Category 1 and Category 2 Change Orders that do not deviate from Construction Standards/Drawings and Gas Work Methods.
- Submitting for approval complex design project Category 1 and Category 2 Change Orders to Project Engineering & Design.
- Submitting Category 3 Change Orders for review by Process Manager, Manager of Complex Construction, Project Manager or Regional Construction Manager
- Maintaining Project Change Order Forms and Change Control Log in the Work Order/Project Folder and or project electronic data base

Project Engineering & Design, Project Management, Complex Construction, Main/Services/Replacement Engineering, Mandated Integrity Programs or designee shall be responsible for:

- Issuing Project Scope Documents and gaining approvals– See Attachment 3 Sample Project Scope Form (Not required when established by project development documentation).
- Initiating the Change Order Form (Attachment 1) for Category 1 and Category 2 Change Orders as necessary.
- Informing Process Manager, Project Manager or Regional Construction Manager of Change Orders.
- Approving non-complex design project for Category 1 and Category 2 Change Orders initiated by Engineering
- Approving all Category 1 and Category 2 Change Orders to complex design projects
- Assisting Operation & Construction in reviewing Change Orders and Completion of Change Order Form for complex projects

- Initiating, as required, and submitting Category 3 Change Orders for approval to Network Strategy and Regional Construction Directors
- Initiating revision of construction standards/drawings and Gas Work Methods as required
- Maintaining Project Change order Forms and Change Control Log in the Work Order/Project Folder and or project electronic data base

Network Strategy, Regional Construction Project Management and Complex Construction Directors shall be responsible for:

- Providing guidance and oversight, as needed, on pending Change Orders
- Approving Category 3 Change Orders

3. Personal & Process Safety

- MAH Assets – All changes to projects concerning assets within the Major Accident Hazard (MAH) portfolio (i.e., gas assets at pressures greater than or equal to 125psig, LNG assets, CNG assets) shall have a process safety risk-based review of the potential change in accordance with ***your company specific procedure***

5. Content

5.1. Change Classification Categories

a. All changes shall be classified using the categories below:

1) Category 1 –
Definition: Does not affect the design's form, fit or function (e.g., an elbow is moved 5 ft. to avoid an obstruction) and has negligible impact to the project's scope, cost or schedule.

i. Usually identified by the construction crew and initiated by the Construction Supervisor or FCC.
ii. Approved by a Design Engineer or, for non-complex design projects only, the Construction Supervisor / FCC or Project Manager.
iii. When a change to an approved SOP is required, Gas Control must be notified.

2) Category 2 -
Definition: Changes that have minor impacts to the project scope and cost and do not impact the overall project schedule.

i. These changes are within the spending limits of the project contingency and do not exceed 10% of the value of the project.
ii. Change is usually identified by the construction crew and initiated by the Construction Supervisor or FCC (e.g., for a significant offset to avoid obstructions) or requested by the Design Engineer (e.g., to either to add or replace a component), thus affecting the design.
iii. Approved by the Manager of Project Engineering & Design or, for non-complex design projects only, the Construction Supervisor /Design Engineer/ FCC or Project Manager when there are no deviations from drawings and/or Gas Work Methods.
iv. When a change to an approved SOP is required, Gas Control must be notified.
v. A Change Order Form or equivalent shall be completed for all Category 2 changes.

3) Category 3 –
Definition: Changes that have a major impact to the project scope and cost and impacts the overall project schedule.
   i. Has costs exceeding 10% of the value of project.
   ii. It adds and/or replaces a major component and incurs significant man hours to the project. It affects the project schedule delivery date, and adds significant dollars to the project.
   iii. Usually initiated by the Process Manager (Construction/Field Ops) from the Originating Organization, Program Manager, Project Manager, Design Engineer, and/or Manager of Project Engineering & Design.
   iv. Requires approval by the Network Strategy Director or Regional Construction/Field Ops Director or Design Manager for Non-Complex projects
   iv. When a change to an approved SOP is required, Gas Control must be notified.
   v. A change Order Form or equivalent shall be completed for all Category 3 changes.

5.2. In Process Design Changes

a. A design change made during the design process before the final design is issued and before long lead material is ordered is an In-Process Design Change.
   1) Project scope and design changes may be requested by any party involved in the project for a variety of reasons. Such scope or design changes shall be evaluated by the Project Engineer and approved by either the Manager of Project Engineering & Design or a designated Project Engineering & Design Team Lead. Such approvals shall be obtained prior to finalizing the design and shall be reflected on the final scope document
   2) In Process Design Changes do not require completing a Change Control Form
   3) A Process Safety Risk based review of the potential change may be required in accordance with ***your company specific procedure***

5.3. Change Order Process

a. The person initiating the request has the responsibility of categorizing the change and identifying the time requirements, as well as the required approvals of the requested change in order to facilitate the project execution.

b. To avoid impacting the overall project schedule the Regional Manager of Project Engineering & Design, Process Manager, Project Manager or Regional Construction/Field Ops Manager shall be responsible for ensuring the required approvals are obtained.

c. The following inputs are recommended for preparation of project change requests.
   1) Sketches, maps, drawings, photographs, memos or other documentation specifying change
   2) Baseline plans of cost, scope, schedule, quality and risk management
   3) Description of the requested changes
   4) Project Status reports
   5) Work performance information
   6) Time reporting system reports
   7) Cost reporting system reports

d. Outputs/Deliverables for Change Order Approval
   1) A completed Project Change Order Form. See Attachment 1, Sample Project Change Order Form.
   2) Revised estimate

3) Schedule variance analysis
4) Preventive and Corrective Actions (If required)
5) Forecast at completion (revised Projected Year End Calculations (PYE)

5.4. Preparation and Approval of Change Orders

a. Category 1 Change Order – Verbal Approval
   1) Initiated By: Design Engineer or Construction Supervisor/ FCC.
   2) Approved By:
      i. Complex Construction: Project Engineering & Design
      ii. Non-Complex Construction: Design Engineer, Construction Supervisor/ FCC or Project Manager

b. Category 2 Change Order
   1) Initiated and Prepared By: Design Engineer or Construction Supervisor/CO Inspector/ FCC or Project Engineering & Design Manager, Process Manager, Project Manager or Regional Construction Manager
   2) Approved By:
      i. Complex Construction - the Manager of Project Engineering & Design.
      ii. Non-Complex Construction - (no deviations from drawings and/or Gas Work Methods) the Design Engineer /Construction Supervisor / FCC or Project Manager
      iii. Non-Complex Construction – (Deviations from drawings and/or Gas Work Methods) Contact Gas Work Methods/Materials and Standards for evaluation and approval.

c. Category 3 Change Order

   Category 3 Out of Process Changes require that approvals be obtained prior to performing the work in the field

   1) Initiated and Prepared By: Project Engineering & Design, Project Management or Construction Reviewed By: Project Manager, or Regional Construction/Field Ops Manager/Design Manager/Design Engineer
   2) Approved By: Network Strategy and Regional Construction/Field Ops Directors or the Design Manager for Non-Complex projects.

5.5. Change Control Log

a. A Change Log shall be kept by the Program Manager, Project Manager, or Regional Construction Manager/ Design Manager for all qualifying projects. See Attachment 2, Sample Change Control Log

5.6. Records Management

a. A copy of the Change Order Form shall be filed with the project documents and/or Work Order Package and a copy sent to:
   1) Complex projects: PE&D
   2) Non-Complex Projects: Regional Construction/Field Ops Manager/Design Manager or Regional Construction Manager
   3) A copy must also be sent to the Construction Control Project Manager

b. A copy of the Change Control Log shall be filed with the Project documents and /or work Order package

Change Control #	Date:	Region:
LDC Company☐	Contractor ☐	Project Information
Name:		Project Name/Address:
Yard/Barn/Location:		Originating Org: ☐ City/State Construction
Change Order Category		Purchase Order #:
☐ 1. Cat1 (Low Impact) ☐ 2. Cat 2 (Minor) (< 10% of estimate)		Project Manager:
☐ 3. Category 3 (Major) (> 10% of prior estimate)		FCC/Supervisor

Project Accounting						
Region	Activity or ACE Code	Work Order No.	Expense Type	Originating Department	Original Estimate	Change Amount or %

Description of Change:

If Temporary change, latest date before temporary change must be removed:

Reason for Change: **☐Field Conditions** **☐Scope Change** **☐Design Change** **☐Other**

Explanation:

Change Notification			
Name	**Title/Position**	**Method**	**Date**
	Originating Organization	☐Verbal ☐ Writing	/ /
	Gas Construction/Maintenance	☐Verbal ☐Writing	/ /
	Resource Planning	☐Verbal ☐Writing	/ /
	Project Management/Engineer	☐Verbal ☐ Writing	/ /
	Other:	☐Verbal ☐ Writing	/ /

Pricing Terms				
Fixed		**Variable**		**Amount(s)**
☐ Lump Sum	☐Unitized Pricing	☐ T&E	☐ Cost Plus:_____%	**$**
		☐ Not to Exceed		**$**
☐ All-inclusive, including all required temporary & final restoration.				**$**
☐ Exclusions:				**TOTAL**
				$

Approval(s)					
Title:			**Title:**		
Print		Date	**Print**		Date
Signature	X______________________________		**Signature**	X____________________________________	

Project Change Control Log

Region/Company:

Project/Work Order #:

						Approval Information		
Date Requested:	**Requested By:**	**Department:**	**Reason for Change:**	**$$ Amount of Change:**	**Recommendation:**	**Approver:**	**Date**	**Yes/No**
				0.00				

Appendix 10

EDR Guideline Safety Management System Conformance Independent Assessment

The NGA Gas System Engineering Design Review Guideline
A Reflection of an API RP 1173 Pipeline Safety Management System

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Introduction

This document demonstrates how the draft Northeast Gas Association (NGA) Gas System Engineering Design Review Guideline (EDR) embodies the elements of API RP 1173 providing an equivalent level of safety to the use of a professional engineer. The EDR provides a process to ensure conformance relevant to local, state and federal construction codes, permit requirements and compliance with pipeline safety regulations. It has been written to allow individual member companies the flexibility to incorporate specific organization policies, procedures, construction practices, drawings strengthened by specific controls. The EDR has been written to conform to the requirements of API RP 1173 Pipeline Safety Management System which serves as a foundation for systematizing and strengthening the EDR process for members companies.

Gas System Engineering Design Review Summary

The EDR guidance document is intended to provide NGA Pipeline member organizations a process framework for developing, enhancing and implementing an organization specific gas system engineering design review protocols. The goal of using a gas system design review process is to ensure that gas transmission and distribution systems are designed and constructed so they can be operated in a safe and reliable manner, increasing the likelihood of reducing incidents to our goal of zero.

The EDR essentially follows a "defense in depth" strategy. By assuring more than adequate levels of protection in the review process, member organizations adopting the practice bring in sufficient, broad technical perspectives to identify potential risks or weak links. The EDR ensures that members integrate this risk-based thinking from design through construction and inspection of construction. The defense in depth is also exemplified through "levels of protection" that are built through the selection of subject matter experts and reviewers who can bring a very robust set of "multi-disciplinary "skills, knowledge and experience to the process. The selection of reviewers includes all affected by the design, construction, start-up, and operation of the system and those who have an added contribution to make through their technical knowledge and experience. Further, this process raises the visibility of the accountability of all involved and makes accountability a continual process. Accountability is intended to be transparent which is an important factor in growing the safety culture in member organizations employing the review process.

Gas System Engineering Design Review Summary (Cont'd)

Engineering design reviews for natural gas system assets and operations can range from:

- *Simple* changes based on field operations enhancements to existing organization specific standard approved designs, to
- *Complex, non-standard* designs that include many linked stakeholders and subject matter experts from the member organization.

Regardless of design complexity, organization size or scale of assets being managed, each organization should have in place a design review process that is conducted by competent personnel that ensures an appropriate review of essential elements of the design with a focus on pipeline/process safety, constructability and operability. Competency is well defined in the process through the detail specified for each role and set of responsibilities.

The design review process requires consideration and evaluation of risk in the process, including but not limited to, specified materials, construction techniques, and operational requirements for management of pressure (isolation and depressurization of segments and systems as well as reintroduction of pressure). The process establishes the use of "Safety Gate Reviews" associated with project design/review/implementation resulting in an end-to-end Safety in Design process.

The Gas System Engineering Design Review Process includes the following content:

- Purpose
- Leadership and Stakeholder Engagement
- Essential Elements of Gas Engineering Design Review
- Training, Education and Experience of Competent Person(s)
- Standard Engineering Designs, Application of Standard Designs, Construction Drawings and Procedure Reviews
- Complex, Non-Standard Engineering Design, Development of Site/Project Specific Non-Standard Designs, Construction Drawings and Procedure Reviews
- Management of Change Policy (MOC)/Operational Controls
- Safety Assurance
- Continuous Improvement Practices Related to Engineering Design/Management Review
- Documentation and Recordkeeping.

The requirements provide a framework of *checks and balances* to ensure facility design, construction, start-up, and operation are performed consistently and more importantly provide pipeline operating organizations with the fundamental guidance to ensure sustainable positive safety outcomes.

Gas System Engineering Design Review Summary (Cont'd)

Within the essential elements, a set of principles are defined to guide operators' execution of the Design Review Process. Application of these principles will bring a level of quality and completeness to the review process which may not otherwise have been in place in operators' practice. Clearly, the guideline is intended to raise the bar, especially through the focus on objectivity, multidisciplinary input, and visible and continuous accountability. The concept of deepening the levels of protection goes directly to avoiding the potential for weaknesses aligning to cause a failure as depicted in the infamous "Swiss Cheese Model".

There is a spirit of inclusiveness underlying the principles outlined which would lead to employees being open to volunteer for participation in the design review processes. Further, the documentation of the reviews for complex, non-standard projects, leading to the signoff of a chief technical executive, expert, or approved designated alternate sends the message that the organization wants to be proud of having a comprehensive process. Transparency in accountability leads to open communication, an essential element of a good safety culture. Improved safety culture leads to improved safety performance, the goal of improved Design Review.

Contribution of API RP 1173 Element Requirements to the EDR Document

The NGA Gas System design review process draws in many of the element requirements of the API RP 1173 Recommended Practice. Inclusion of the API RP 1173 elements in the design review process results in required actions by individuals and the organization consistent with key Leadership, Stakeholder Engagement, Risk Management, Operational Control, Lessons Learned, Safety Assurance, Management Review/ Continuous Improvement, Competency/Training, and Documentation principles, all of which serve to strengthen and add cohesiveness to the design review process.

The structure of this Design Review essentially follows the principles of Plan, Do, Check, Act, which underpins the API RP 1173. With the focus of the Gas System EDR being on inclusiveness of layers of protection, it opens the process to employee involvement and contribution of personal responsibility on their part. This concept is central to API RP 1173. The following summary ties many of the Gas System EDR design review requirements to key API RP 1173 element requirements.

Leadership

- The Gas System design review process establishes the expectation that the organization will conform to specific standards, processes, and procedures.
- Leadership by undertaking this enhancement to design review is making a clear commitment to improved safety and system reliability.

Leadership (Cont'd)

- The process sets the expectation that all personnel and contractors who participate in the design-construction review process do so commensurate with scope and complexity of design/design change under review and consistent with their training, knowledge and competency.
- Roles, responsibilities, authority and accountability for each position are clearly defined for execution.
- Member company Leadership, adopting the design review process, establishes the Delegation of Authority necessary for Engineering Approval and visible sign off by a senior technical executive on the final company specific design review process/procedure.

Stakeholder Engagement

- The design review process requires utilization of personnel from all parts of the organization, as appropriate, including field operations, engineering (including Professional Engineers and/or Technically equivalent), consultants and contractors.
- Leadership communication welcomes employee involvement and taking ownership of the assets as their personal responsibility.
- Emphasis on transparency leads to an open environment where employees would feel safe about offering their safety concerns.

Risk Management

- The review process includes a requirement for assessing design/operational risk, where appropriate, including identification of potential abnormal operating conditions (AOC's) resulting from design implementation.
- The process includes consideration, based on design/operational risk, of a Pre-Startup Safety Review process (PSSR) and a System Operating Procedure process (SOP) where required.
- The process requires identification of potential risks associated with the change and any required approvals prior to introduction of such changes.

Operational Controls

- The design review process requires organizations using the design review process to maintain and utilize written construction, maintenance and operations procedures.
- The process requires review of material specifications, system/equipment design, construction processes and field construction inspection consistent with design requirements.
- The process contains requirements for a robust MOC process consistent with the requirements of API RP 1173.
- Emphasis on accessibility increases the likelihood of consistent use of approved procedures and better quality control.

Incident Investigation, Evaluation, and Lessons Learned

- The design review process requires a continuous improvement process related to engineering design to incorporate the results of incident investigations, evaluations and lessons learned.
- Consistent monitoring through management review of lessons learned and applied provides greater assurance learning is applied system wide from specific findings.

Safety Assurance

- The design review process requires the use of pre-defined "Design Review Gates", creating an objective and transparent review process that, in many cases, is independent of the original design review process based on design complexity.
- The process requires, when specified, use of individual(s) not directly involved in the process to ensure that conflicts of interests do not arise.
- Commitment to an audit of this process as a priority provides an added level of safety assurance.

Management Review and Continuous Improvement

- The design review process specifies use of a continuous improvement process requiring the use of periodic reviews of gas system designs to ensure that changes to specific designs, feedback from lessons learned, and evaluation of risk are feedback to the training organization.
- Periodic reviews of metrics are required such as stakeholder feedback; equipment reliability, performance and availability; gas system operational performance; incident investigations, near-miss evaluations and lessons learned; and results of risk management reviews, internal and external audits.

Competency, Awareness and Training

- The design review process requires that design reviews are carried out by suitably trained, competent individuals who are experienced in gas system design and operations possessing the ability to comment constructively from the standpoints of constructability, operations, pressure control and work site safety.
- The process establishes training, education and experience requirements for personnel deemed as competent to carry out the design-construction review process.
- Specific competency requirements are very detailed for each role in the process along with sources, options, and variations to provide adequate knowledge required.

Documentation and Record Keeping

- The design review process contains requirements for identification, distribution, and control of documents to memorialize the review process.

- The process requires identification of the approval authority for document approval/sign-off, re-approval and assurance that documents and records supporting the design review process are readily identifiable and available for future use.
- Requirements for accessibility and transparency provide an added level of assurance that employees can reliability find and use what is needed.

Conclusion

The guideline makes a clear case for how a robust design review *process* provides better protections through layers supported by a structured process rather than relying on a single credentialed individual (PE). Through an emphasis on visible and transparent accountability, employees will be motivated to add their perspective, adding a sense of more well-rounded review. Operators undertaking this design practice will realize how the bar is raised through greater completeness and comprehensiveness of reviews and be able to execute reviews with greater certainty as to the goal of zero incidents. Finally, the principles espoused in this guideline reinforce the sense of openness in communication and information flow needed to nurture a healthy safety culture important to inform better decision making.