A PROEDURE FOR DEVELOPING CODES AND STANDARDS FOR THE NATURAL GAS INDUSTRY IN ASIAN-PACIFIC RIM NATIONS

by

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Paper Presented at
Asian Natural Gas III — New Markets and Distribution Methods
Singapore

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ABSTRACT

An important consideration for developing nations planning to provide or expand their natural gas infrastructure is adapting a procedure for developing codes and standards for design, installation, operation, and maintenance of the facilities required to deliver natural gas from the wellhead to the customers.

Codes and standards for performance and material specifications adapted to the climatic, geographic, and demographic conditions of the country will provide the natural gas industry with the basic rules to assure proper and safe operation. A procedure is proposed for developing and implementing codes and standards.
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INTRODUCTION

The development or expansion of a natural gas infrastructure has become a high-priority mission throughout the developing nations of the Pacific Rim and Southeast Asia. A recent assessment of energy supply and requirements balances by the Resource Systems Institute, East-West Center, indicates that unless reserves are discovered and developed, only Brunei will be able to continue exports at current rates into the 21st century.\(^1\)

This is due, in part, to decreasing oil production as reserves are depleted, but it also reflects the increase in energy demand as the economies of these nations continue to become industrialized.

Natural gas should be considered a prime source for supplying these increasing energy requirements:

- It is environmentally benign, emitting the lowest levels of air pollutants of any fossil fuel. As an alternative to other fossil fuels, it can significantly reduce emission of greenhouse effect gases and assist in achieving a clean air environment.

- It is available in large volumes. The current reserve to production ratio for the area is more than 70 years, and each year reserves are increasing as new discoveries are being made.

- The use of locally produced natural gas to displace oil could make oil and oil products available for export and improve trade balances.

- Gas is most advantageously used in domestic markets that can be reached by overland pipelines.

Some of the problems that will be encountered in developing a natural gas delivery infrastructure are the following:

- The initial investment costs are very high; both for the supplier and user. The natural gas supplier must provide facilities for purification and dehydration. Transmission facilities required to deliver natural gas from the production source to a distribution system include pipelines, compressors, meters, and pressure control equipment. The distribution system consists of mains, services, meters, and equipment to regulate pressure. These facilities are usually designed to provide greater capacity than required during the initial years of operation since it is less expensive to build in excess capacity in the original installation than to install additional facilities to meet increasing demands in the future.
The customer has to invest in the purchase or conversion of gas-fired equipment and the fuel lines on his premises. In the case of a power generating plant or an industrial plant, the investment cost for converting large boilers and installing gas burners can be substantial, but even the small commercial or residential customers' investments can represent a sizeable amount in relation to their income.

The natural gas industry has established an exceptional safety record and, when properly used, natural gas is a safe and dependable energy source. Instruction to customers, employees, and the public in general on the safe use of natural gas is important to prevent unintentional escape of gas and assure proper combustion.

The operation and maintenance of a natural gas infrastructure requires specially trained personnel to assure safe and proper operation and performance of maintenance activities to provide assurance that the facilities will be serviceable throughout their full useful life.

The development of new natural gas systems in the developing nations will, by economic necessity, concentrate on service to large users such as electric power generating stations, and steel, cement, and fertilizer plants. This type of load is necessary to produce the revenues required to amortize the capital cost of the gas facilities. Service to residential and small commercial customers which produce a much smaller return on investment and, in some cases is subsidized, will probably be deferred.

In most cases, because private enterprises would have difficulty raising the capital required for the initial investment, the transmission and distribution facilities will be owned and operated by the central government.

One might question the need for codes and standards at this early stage because the facilities are limited and the market consists of customers with large, well-staffed technical departments that are familiar with good engineering design concepts. Developing codes and standards at an early date will assure consistency in design and installation of facilities from the onset of natural gas development. Furthermore, because the pipelines will pass through populated areas, it is important to provide standards that will assure the utmost public safety. Consistency in design, installation practices, operating, and maintenance functions will also serve to keep operating expenses at the lowest possible level, thus increasing the value of the facilities for sale in the event of a decision to privatize the industry.
DEFINITIONS

Before suggesting a plan for developing codes and standards, definition of the terms that are used and their relationship to each other is needed. Although the codes and standards cited in the following discussion apply to the United States, there are codes and standards from other nations that are equally applicable.

Standards. The recommended minimum specifications or procedures necessary to assure safe and proper design, installation, operation, and maintenance. Standards provide for consistency and are used to measure performance.

Standards are developed by engineering and manufacturing groups that have the expertise and experience with regard to limitations of materials, the procedures for installation and operation, and correct maintenance practices. Support for standards is provided by analysis and testing in facilities established for that purpose and practical field experience.

Standards are not mandatory, but are accepted voluntarily by responsible persons as good, normal practice. Many standards were developed at the urging of insurance companies to provide uniformity in practice and to assure the facilities were constructed using good engineering principles. Standards were also adopted as the result of government action involving public health, safety, and welfare.

The following are different names for standards:

• **Material Specifications** -- Standards that establish limitations on the use of a material for specific functions and the quality of material required for a particular use. A typical example is the American Petroleum Institute specification for Line Pipe (API-5L) which is a standard in use throughout the world. There are literally thousands of standard material specifications applicable to the natural gas that cover every item used. The American Society of Testing and Materials Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Externally Threaded Fasteners ASTM-A354-92, is an example of the "nuts and bolts" detail of standards applicable to the gas industry.

• **Recommended Practices** -- Standards that provide procedures for the proper handling of materials and for methods of performance. Examples are the National Association of Corrosion Engineers Standard for Control of External Corrosion on Underground or Submerged Metallic Piping Systems (NACE-RP-01-69), and the American Petroleum Institute Recommended Practice for Railroad Transportation of Pipe (API-RP5L1).
• **Standard Methods** -- Standards similar to recommended practices that provide procedures for methods of performance. Examples are Standard Method for Analysis of Natural Gas - Liquid Mixtures by Gas Chromatography ASTM (D2597-83), and Standard Test Method for Short-Time Rupture Strength of Plastic Pipe, Tubing, and Fittings ASTM (D599-82).

• **Safety Procedures** -- Standards and recommended methods of performance to assure maximum personal safety to employees and the public. Examples are, the American Welding Society Standard for Safety in Welding and Cutting (AWS-249.1-83), and the National Fire Protection Association Standard for the Prevention of Furnace Explosions in Fuel-Oil and Natural Gas-Fired Single Burner Boiler Furnaces (NFPA 85A).

**Codes.** A group of standards pertaining to one major subject. Generally, a code will provide the information required for compliance with the standards applicable to that subject. Rather than reciting each standard within the text of the code, many of the standards are incorporated by reference and listed as an appendix to the code.

Examples of codes are the American Society of Mechanical Engineers Code for Pressure Piping, Gas Transmission and Distribution Piping Systems (ASME B31.8), and the American National Standards Institute National Fuel Gas Code (ANSI Z223.1).

**Regulations.** Official rules that are mandatory and enforceable by law, unlike the codes and standards that are voluntary. Regulations are developed by enactment of legislation or an official decree that establishes a new, or empowers an existing, governmental bureau or agency with the authority to prepare and issue regulations governing specific activities. The agency is provided with enforcement power necessary to assure compliance with the regulations, and failure to comply may result in criminal, as well as, civil penalties.

As an example, the Natural Gas Pipeline Safety Act (NGPSA) empowered the U.S. Department of Transportation (DOT) to promulgate regulations regarding pipeline safety. The DOT created the Office of Pipeline Safety (OPS) to perform this task. The OPS has issued regulations entitled Minimum Federal Safety Standards for the Transportation of Natural and Other Gas by Pipeline. These regulations apply to all operators of gas distribution systems.

The OPS adopted the ASME B31.8 code as an interim regulation which was effective until new regulations were issued. Since the enactment of the
Natural Gas Pipeline Safety Act in 1968, numerous amendments have been made to keep these regulations contemporary with the introduction of new materials and techniques.

HISTORICAL BACKGROUND

Codes, standards, and regulations are the product of many years of experience of operations of gas delivery systems. They are continually being revised to provide for new materials and technology and new uses for gas.

Although good engineering practices were the rule during the early years of the industry, there was little uniformity in the standards in use. Creation of public utility commissions during the first decade of this century provided a measure of regulatory control over operations and the publication of the B31.8 code in 1944 gave the U.S. industry its first minimum standards code.

Appliance Safety Standards were developed in the early stages of the industry to protect the consumers. These standards and appliance certification programs that have been introduced assure the public that appliances are of high quality and will operate safely and efficiently.

DEVELOPMENT OF CODES AND STANDARDS FOR THE GAS INDUSTRY

A great advantage to a country that is just starting on planning a major project for installing a new or expanding an existing natural gas system is that it is not necessary to start at the beginning to prepare new standards and specifications for its codes and regulations. These standards are already available, but they need to be reviewed and modified to suit the particular needs of the country.

Although use of existing standards as a starting point will assist greatly in the effort, the development of codes and standards will be a time-consuming task. The preparation of standards requires a review and approval process to assure feedback from everyone that is involved in the gas industry. Proper standards are those that are based on good, practical engineering principles considering the needs for public safety. The inclusion of excessive restrictions and unnecessary constraints could cause a significant increase in investment and operating costs with no appreciable improvement in public safeguards.
The development of codes and standards should be a cooperative effort of government and industry. Implementation would begin when the government enacts legislation empowering a governmental agency to develop and implement regulations for the natural gas industry. The agency should be granted enforcement powers, with authority to monitor activities and require status reports from the operators under its jurisdiction. It, in turn, should report the results of its activities and the effectiveness of its regulations to the legislature.

The agency would form a steering committee to oversee the activities involved in preparing the standards. The committee should consist of government and industry officials with responsible positions in energy, commercial, and industrial development. The agency should also designate staff personnel to prepare a master plan for developing regulations. Drafts of standards for specific subjects could be prepared by technical committees consisting of staff and industry personnel with expertise in the assigned area.

Technical committees could be organized along the lines of gas industry segmentation. Each committee would be responsible for the safety aspects of that industry segment. Areas that overlap industry segments such as corrosion control, could be assigned to sub-committees with representation from each of the technical committees.

The industry segments are the following:

- Gas processing with responsibility for standards for gas quality,
- Transmission covering the facilities between the processing plant and the delivery points to distribution systems or large customers. Responsibilities would involve storage, metering and pressure control, compression, pipeline and appurtenances, and corrosion control,
- Distribution involving the facilities from the transmission delivery point and the connection of customers' piping, and
- Utilization covering the piping and appliances used by the customer.

This committee would also be responsible for developing standards for LP-gas operations unless a separate committee is formed to perform that function.
A process for review and comment of the draft standards prior to agency approval should be implemented. Approved standards would be aggregated into codes and adopted as regulations.

The agency should have a technical library to collect support documentation for use by the technical committees and to distribute copies of approved regulations.

There should also be a laboratory for testing materials and arrangements should be made for training personnel of the agency and the gas industry in methods and procedures for design, installation, operation, and maintenance of gas facilities.

With regard to consumer safety, a facility should be provided to test and certify appliances as safe and efficient. Manufacturers are usually required to obtain certification before distributing appliances and equipment for resale. The certification, however, is on a country-by-country basis. Each country, therefore, should require certification of an appliance prior to its distribution within the country.

A certification program for both imported and locally manufactured equipment and appliances will provide assurance to consumers that the equipment and appliances have been tested and are safe when used in accordance with the manufacturer's specifications.

SUMMARY

This paper has outlined a procedure for developing codes and standards for the natural gas industry in developing nations. The purpose of developing codes and standards is to assure the application of good engineering principles, consistent design and installation of facilities, and proper operation and maintenance practices. Compliance with regulations adopted by using the codes and standards developed will assure safe and efficient service from facilities throughout their useful life.

This procedure recommends the formation of technical committees with representatives from the government and industry sectors in order to provide the expertise for preparing standards applicable to assigned segments of the industry. The overall development of codes would be the responsibility of a government agency authorized to assure compliance and staff and facilities to
perform the ongoing functions relative to codes and standards.

An agency, staffed to assist the technical committees should also have facilities for certification of gas appliances and equipment to be marketed within the country. This staff can also conduct studies and research in the use of natural gas in ways that will enhance economic development and improve the environment.

REFERENCE CITED
