Increase in Design Factor – Phase 3

Researchers developed a comprehensive waiver package and technical information to help support regulatory changes for an increase in the design factor used to determine the maximum safe pressure for plastic gas piping systems. Research shows that such an increase would maintain safe operations while helping to provide more flexible system designs (based on capacity considerations), cost savings, and the ability for companies to bring natural gas service to new areas.

Project Description

In efforts to enhance the effectiveness of the natural gas piping infrastructure, gas distribution companies have expressed increasing interest in being able to use their plastic piping systems at their maximum capabilities. These interests have been supported through various regulatory initiatives developed through the American Gas Association (AGA), Gas Piping Technology Committee (GPTC), Plastics Pipe Institute (PPI), Gas Technology Institute (GTI), and others.

In 2004, the Department of Transportation's (DOT) Office of Pipeline Safety adopted an amendment that governs the minimum requirements for the safe use of plastic piping systems. Specifically, rules were changed to increase the maximum design pressure of plastic piping from 100 psig to 125 psig. However, industry leaders suggest that additional changes are still required to provide gas distribution companies with the ability to maximize the benefit of using plastic piping systems. In particular, the industry is seeking to increase the design factor from 0.32 to 0.40.

To help facilitate the necessary technical justification for an increase in the design factor, OTD supported a comprehensive research program to develop data that demonstrate that the overall safety and system integrity are not adversely compromised by a design factor increase to 0.40.

Early phases of the program – detailed in a technical report for sponsors – addressed:

- Material performance differentiations between various grades of polyethylene (PE) materials
- The impact an increased design factor has on construction and operations practices
- Targeted field installations to install PE piping with the use of an increased design factor to characterize geographic and climatic effects
- Projected benefits for both utility companies and the general public.

This phase of the project focused on activities to allow for the approved use of an increased design factor via "special permits" at both the state and federal regulatory levels.

Deliverable

The deliverable for this phase of the project is the development of a comprehensive waiver package and technical support to help gas companies gain the approval of state and federal agencies for the use of an increased design factor within specific utility service territories.

Benefits

There are several benefits associated with this project, including:

- Technical substantiation for the increase in the design factor on the basis of technical data generated through a comprehensive program (laboratory testing and field demonstration) with input and support from all key stakeholders (utility companies, regulatory agencies, and pipe and fitting manufacturers)
- The ability to use plastic piping systems to their maximum potential without sacrificing safety
- The potential for increased cost savings resulting from reduced material, installation, and maintenance costs; and greater flow capacity for a given diameter
- Environmental benefits due to a reduction in the amount of plastic that is used to produce the pipe
- Increased ability to provide natural gas to customers in remote areas that were not being served due to prohibitive piping/installation costs.

Technical Concept & Approach

Investigators worked with leading utility companies, pipe and fitting manufacturers, and regulatory staff to develop a comprehensive program plan.

The project was divided into three distinct phases:

Phase 1: Resolve material performance differentiations between the various grades of PE resins (ISO methodology, ASTM methodology, unimodal and bimodal HDPE, etc.); and develop minimum material-performance-based requirements that ensures safe and long-term service with the use of an increased design factor.

Phase 2: Develop comprehensive technical data through testing and evaluation to characterize the impact of an increased design factor on critical construction, maintenance, and operations practice (joining, squeeze-off, etc.)

Phase 3: On the basis of the minimum material-performance-based requirements and testing data, perform targeted field installations under a waiver to install PE piping under an increased design factor.

Specific tasks included:

- An evaluation of construction operational requirements (e.g., joining, flow control, and appurtenances)
- An evaluation of joints made from butt heat fusion, saddle heat fusion, electrofusion, and mechanical means
- An evaluation of squeeze-off performance.

Results

Calculations show that an increase in the design factor from 0.32 to 0.40 would increase flow capacity by as much as 11% with a 17% reduction in the plastic resins used to make the pipe.

Evaluations demonstrated that modern PE materials could safely be used at increased pressures determined with a 0.40 design factor, with an ample degree of safety against various types of risks and threats (e.g., secondary stresses). Long-term sustained pressure testing at pressures based on a 0.80 design factor showed that there were no failures at test times significantly greater than the theoretical 50-year intended design life. In addition, testing to characterize the integrity of various types of joints demonstrated that the use of existing procedures and practices that are in place could produce consistently strong, quality joints that will provide safe, long-term performance.

In 2007, interactions began with utility companies and state regulatory agencies to help coordinate and execute waiver filings. Researchers provided technical updates and developed a waiver template to facilitate the process.

In 2008, continuing progress was made towards meeting program objectives. Most significant were special permits that were approved in 2008 in Arizona, Indiana, Tennessee, and New Jersey.

Investigators also engaged in various interactions with representatives from DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) to provide written statements for approved special permits in various states.

Significant progress was made in quantifying the environmental benefits related to IDF changes. An analysis and technical reference report were prepared to provide the economic justification (cost/benefit, capacity impact, and environmental impact) of the IDF program – which will be a necessary item for any proposed petitions to PHMSA.

Status

A Final Report on this project was issued in January 2009.

The project team is continuing interactions with various utilities interested in filing special permits to use a 0.40 design factor. The team is also continuing to pursue a change to the U.S. Title 49 Code of Federal Regulations Part 192 requirements to allow for the 0.40 design factor versus the current 0.32 design factor.

For more information:

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