
**FIRST MAJOR IMPROVEMENTS TO THE TWO-CURVE DUCTILE FRACTURE
ARREST MODEL – EFFECT OF DIFFERENT SOIL TYPES ON DUCTILE
FRACTURE ARREST, AND SEPARATING ELASTIC AND PLASTIC
CONTRIBUTIONS TO THE CRACK-DRIVING FORCE**

Summary

The objective of the proposed program is to make the first major improvements to the most commonly used ductile fracture arrest criterion. There are two tasks in this effort.

The first task is to improve the accuracy of the Two-Curve Ductile Fracture Model to be able to account for different types of soil backfills, i.e., sand, clay, etc. To make this improvement, a series of intermediate-diameter (6 to 12-inch) pipe burst tests with different soil types, compaction, and moisture content will be conducted at the Emc² burst test site in the Mojave Desert in California.

The second task involves making an improvement to the crack-driving force equations in the Two-Curve Method so that there will be elastic and plastic contribution to the crack-driving force. Experimental results have shown that the arrest toughness value determined from the Two-Curve Ductile Fracture Model should be continually increased as the grade of the pipe is increased. A significant portion of this empirical correction comes for the elastic energy being higher than was accounted for in the current Two-Curve Ductile Fracture Model. Making this improvement will allow for safer future pipeline design with higher-grade steels.

Progress as of December 2003

This program was initiated as of September 9, 2003. In this first quarter of this program, the general program management structure was developed and initiated. In addition, test preparations have begun for the first series of Mojave tests that are planned to be conducted in the second quarter of 2004. Several pipe mills and suppliers were contacted in order to find intermediate diameter low toughness pipe for use in these experiments. Finally, the review of past technical papers pertaining to the development of the current crack-driving force equations has begun. Several documents have been gathered and reviewed.

On November 12, 2003, a kick-off meeting between Emc² staff, the DOT program monitor and a representative from PRCI (team cost-sharing partner). The basic program strategy and the overall program objectives were discussed.