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Caltrans Division of Research, Innovation and System Information

Research Results

Encasement Research: Effective Utility Encasement Criteria and Methods

Proposed objective of adequately substantiated encasement specifications are needed to prevent damages to the state facility from failed utility carriers in state right of way, ensuring safety of the motorists and the community.

Design

JULY 2019

Project Title:
Effective Utility Encasement Criteria and Methods

Task Number: 3106

Completion Date: May 15, 2019

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WHAT WAS THE NEED?

Utility related dig-in accidents result in jeopardizing safety, incur huge costs for repair, disrupt highway operations and result in environmental hazard situations. Often incidents occur due to lack of information on risks associated with subsurface utilities within highway right of way – particularly for uncased facilities. Although Caltrans allows utilities regulated by California Public Utilities Commission (CPUC) and private utilities to be installed within highway right of way, there are not many unified literatures of references with regards to encasement standards for utilities. Data from the Pipeline and Hazardous Materials Safety Administration (PHMSA) show that pipeline incidents have been significant for last 20 years for federally-regulated and state-regulated natural gas pipelines, hazardous liquid pipelines, and liquefied natural gas (LNG) plants. California has seen several pipeline incidents over last several years with the average total cost of incidents running in several millions of dollars each year. Preliminary reviews of literature have shown that there is lack of reasonable guidance on design of encasement for pipeline utility protection across different states of the nation. Although there are design manuals for utility related facilities in California, there are only few isolated recommendations on encasement specifications for protecting utility facilities. There is gap in research in identifying the most effective encasement methods, standards, and specifications for each specific kind of utility.

WHAT WAS OUR GOAL?

There were four key objectives of this encasement research. The first was to provide statistics and compilation of underground pipeline incidents across the nation due to excavation-related damage. Additional information regarding any encasement

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that protected the pipelines from excavation-related accidents were also documented under the first objective. The second objective of this research was to document encasement standards for protecting underground pipelines. The third objective was to document gas migration across various soil texture types to the surface once a leakage starts from a buried damaged pipeline. The fourth and the last objective was to document existing trenchless technologies for underground pipe replacement and encasement details for subsurface utility installations from some key states of the nation.

WHAT DID WE DO?

Encasement information was researched for gas transmission pipelines that were involved in excavation-related incidents. Online web searches were used for conducting this research. The PHMSA was the primary data source used for compiling all the excavation-related damages and incidents to buried pipelines. Specific focus of this research was comparison of incidents in California versus other states of the nation. Research was also focused on drawing conclusion based on the information if encasement would have prevented excavation-related damages incurred to gas pipelines in California. References were also made to existing Federal standards on underground pipelines - such as the Code of Federal Regulations (CFR). Literature reviews were also carried out to document behavior of gas migration in various soil texture types. There were three soil texture types that were studied in this regard- sand, silt and clay. Information on some common trenchless technologies for replacement of underground gas pipelines were also studied and documented in this research. Encasement standards and dimensions for protecting high priority utilities such as gas transmission pipelines were provided from states such as Alabama, Texas and others – with comparisons made to California standards and policies.

WHAT WAS THE OUTCOME?

An analysis of a 'cased' versus an 'uncased' gas transmission pipeline leakage across the United States showed that majority of the leaks were due to excavation-related damage to uncased pipes. The historical data showed that natural gas migration after leakage from an underground damaged pipe is complex and unpredictable if the surrounding soil has a high clay texture content Sand, on the other hand, provides a much predictable gas migration profile to the surface. Based on the historical data and literature research from the available pipeline incident data, having an encased pipeline would have prevented damage to pipelines or reduced severity of the incidents during excavation. Based on this historical data a decision support tool was developed for encasement assessment. A more comprehensive data-based tool could be developed, that would be representative of different soils and site conditions under which encasement needs could be evaluated in future.

WHAT IS THE BENEFIT?

Underground natural gas pipeline leakages at roadway crossings result in jeopardizing safety, incur huge costs for repair, disrupt traffic operations and create environmental hazard situations. Completion of this project showed how encasement was implemented across various states of the country. Caltrans (and other state DOTs) benefit from this project on various aspects: improved safety of workers at highway right-of-way, adequate encasement can prevent both fatal and non-fatal injuries at dig-in sites, enhanced traffic operational efficiencies (with the knowledge of encasement policies unprecedented traffic delays can be prevented due to damage to high pressure pipelines at roadway crossings) and increased cost savings (reduction in cost due to limiting or eliminating gas leakage if cased or uncased information is provided and excavation-related damage to pipeline is prevented).