Hydrogen Pipeline Engineering

Horace Heffner December, 2005

A hydrogen "economy" wherein hydrogen is produced at filling stations, or other local area places of demand, provides no energy source. It merely uses hydrogen as an energy token. It is not a real energy economy, a real solution to the energy problem, because no energy source is provided. Existing forms of energy are converted to hydrogen and through the conversion process overall global energy efficiency is reduced.

Hydrogen produced at the location of actual energy sources, like geothermal, solar, wind or nuclear hydrogen generating nuclear plants, requires hydrogen transport. Pipelines are the common method for making typical medium distance gas trades over land . Hydrogen pipelines will likely be necessary to achieve the dream of conversion to a true hydrogen economy.

Much discussion is made of the research and delay required to utilize the hydrogen in this new economy, e.g. in motor vehicles through as yet non-economical fuel cells. However, the research required to build hydrogen pipelines may take much more time than that required to engineer hydrogen utilization devices. Hydrogen pipeline research must begin now if the hydrogen energy economy dream is expected to be fulfilled in a 30 year time frame. Existing natural gas transmission companies are likely candidates to do this research.

Hydrogen transmission line engineering may have some problems and surprises in store due to hydrogen embrittlement. This would especially be a problem for the gas turbines that power a pipeline and which would be hydrogen fueled as well as for the compressor blades used to push hydrogen upstream in the pipeline. High pressure valves, bearings, seals and lubricants would have to be tested long term, etc. Merely converting existing natural gas pipelines is not a reasonable approach, at least not without major engineering and long term testing.

Much engineering related to transmission line operations has to be accomplished as well, like modeling line pack, supercompressibility effects, jet engine performance, storage reservoir performance, and other parameters currently used in natural gas transmission simulations and operating models. Transmission lines are considerably different from distribution systems, and a lot more dangerous. Broken natural gas transmission lines can and have wiped out large areas by explosion. Hydrogen transmission lines might be able to do the same thing. The problem is doing the engineering to find out what kinds of maintenance and operating procedures must be used to prevent catastrophes.

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In addition to the work required for hydrogen transmission systems, hydrogen distribution networks require specialized engineering and construction research, including piping, metering, and regulation devices. New modeling and planning tools are required.

A major project is clearly mandated which consists of component identification, engineering, prototype construction and testing, to be followed by a system integration including a transmission pipeline loop, with attached distribution system. This would not be a system for commercial use, but rather a system solely for engineering and testing purposes. Such a system would have an importance similar to that of the major wind tunnels operated by NASA.

If we are serious about a hydrogen economy, this kind of engineering and integrated testing should proceed soon.