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SOUTH DAKOTA PUBLIC UTILITIES COMMISSION

July 6, 2007

Public Utilities Commission
Capitol Building, 1st floor
500 East Capitol Avenue
Pierre, SD 57501-5070

Re: HP07-001 TransCanada Keystone Pipeline Project

Gentlemen:

I am a native of Mitchell and returned following retirement after nearly 40 years in the field of pipeline engineering and design. My work involved pipelines for transport of natural gas, helium, water, crude oil, refined petroleum products, liquid fertilizers, carbon dioxide, and many slurries. My specialty was thermohydraulic design of pipeline systems, and to this end I operated a fluids laboratory and test facility for the purpose of defining fluid properties and design requirements for both domestic and international projects. I hold a Bachelor of Science degree in Physics.

I can understand the reticence of many of our citizens to embrace a project of the scope and size of TransCanada's Keystone Pipeline; landowners who would be directly affected as well as other interested parties. South Dakotans do not live in "pipeline country" and it is a new concept to many. My concern is that some of the opposition to the pipeline stems from erroneous statements and misinformation, some of which seems to be disseminated by individuals who should know better. The purpose of this letter is to address several of these issues.

I am not associated in any way with TransCanada or the Keystone project. My interest stems from my belief that the pipeline and its long-term access to Canadian crude oil is a much needed resource which would be beneficial to South Dakota as well as the rest of the Country. The project deserves a hearing based on facts, not rumor and conjecture. With that said, I offer the following comments on several aspects of the project which have received media attention lately and/or have been subjects of discussion during your recent public hearings.

Installation along the I-29 right-of-way. This issue should have been resolved by the comments presented by the Keystone Project team during the public hearing in Alexandria, SD on Monday, June 25. The problems associated with the concept were clearly spelled out

Roads and highways are generally sited to connect cities and towns, population centers that a well conceived cross country pipeline system would avoid where possible, even if the width of highway right-of-way (ROW) available for pipeline construction were adequate. (Generally, they are not. The construction ROW would have to encroach on land adjacent to the road.) There are two main reasons for this: major disturbances to the urban infrastructure during construction and future maintenance, and significantly higher construction costs in these areas. Outside the city, there would be the problem of numerous overpasses, underpasses, culverts, and access ramps which would be disturbed.

This problem has been addressed many times in the past. It has always seemed to me that the more limited an individual's knowledge of cross-country pipeline systems, the more that individual is convinced that the highway ROW concept offers the optimum route selection.

Pipeline operating pressure and pipe wall thickness. The Keystone pipeline will be designed in accordance with ASME Code B31.4, *Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids*, as are all liquid hydrocarbon pipelines constructed in North America and much of the rest of the world. One of the provisions of Code B31.4 is that the maximum allowable operating pressure (MAOP) must not exceed 72 percent of the specified minimum yield stress (SMYS) of the pipe. This means that line pipe intended to operate at 1440 pounds per square inch (psi) would actually be capable of accommodating 2000 psi.

For a given diameter of pipe, the wall thickness necessary to provide these conditions depends on the grade of steel to be used. Once the grade of steel is established, the required wall thickness is calculated.

I assume the 1440 psi system represents the optimum configuration for the Keystone pipeline, based on their evaluation of dozens (or hundreds) of combinations of pump station size and spacing, pump unit capacity and number of units (operating/standby), line pipe diameter, grade and wall thickness. Reduction of the operating pressure would mean more pump stations required, and the thinner wall thickness of the pipe for the lower pressure scenario would still be determined as described above.

It might also be pointed out that 1440 psi would exist only at the discharge of a pump station. The pressure along the pipe will decrease linearly as the flowing stream moves to the next pump station and will arrive at that station at 50-100 psi. (I am not privy to Keystone's design. This estimate of pump station suction pressure is based on my experience.) The average, or mean pressure in any given section of line between pump stations will be on the order of 650-700 psi.

The system design is based on the ultimate anticipated throughput of 590,000 barrels per day (BPD). At the initial flow rate of 435,000 BPD station discharge pressure will be less than 1440 psi because of the lower friction loss resulting from the lower flow velocity. Calculation of discharge pressure for the lower flow rate would require knowledge of the crude oil rheology (viscosity, density, yield stress), data which are not available to me. However, TransCanada stated at the Alexandria meeting that this would be approximately 1000 psi. That would be the station discharge pressure for as long as the system operated at the lower flow rate.

TransCanada plans to hydrostatically test completed sections of the pipeline at 125 percent of MAOP. These sections will be isolated, charged with water, and pressurized to 1800 psi. Pressure and temperature will be monitored for a time period set by the construction specification (probably 24 hours, although the Code provides for less) and any pressure drop in excess of that due to temperature change would indicate a leak. The defect will be located, repaired, and the hydrostatic test will be repeated. This test pressure, well above any pressure the system will experience during operation, is designed to find and identify defects that might never be detected during normal operations.

The concern over pipeline operating pressure probably stems from the belief that the higher the pressure, the more likely the pipe will rupture. This is not the case. The Keystone pipeline, as proposed, would be no more apt to rupture than would a system designed and operated at lower pressure.

A recent newspaper article quoted an individual as saying that if the pipeline ruptured, friction due to the pressure would cause the oil to ignite. I and my associates have never heard of such a phenomenon. Fire resulting from liquid hydrocarbon spills is almost always the result of ignition from external sources.

Leaks. Most pipeline leaks are the result of corrosion. The crude oil proposed for transport in the Keystone system is not corrosive, so external corrosion is the main concern, as it is with all underground steel pipeline systems. This occurs when the pipe coating is somehow breached and the bare steel comes in contact with the ground. The result may be oxidation (rust) or electrochemical interaction with its surroundings, or both.

Historically, the most common pipe coating has been to apply a primer to the cleaned pipe, followed by a layer of coal tar enamel, then fiberglass or fiberglass-reinforced felt, and finally heavy kraft paper outer covering. This method of coating and wrapping may be done at the mill where the pipe is produced, at a pipe yard near the construction site, or over the ditch in a continuous operation just prior to lowering the pipe into the ditch.

In recent years the use of polyethylene, polyvinyl, or butyl-mastic tape has been used for over-the-ditch coating. It is probably more expensive than the method described above, but it is less subject to damage during the bending and lowering-in operations. Any defect in the application can be easily identified and repaired.

The best coating material is fusion bonded epoxy. It is usually applied at or near the pipe mill and, as the name implies, becomes almost a part of the pipe. It is highly resistant to damage, and any damage that might occur in shipping or handling is easily detectable by visual inspection and repaired. Field bends will not cause it to crack or separate from the pipe. Another advantage is that it eliminates the field coating operation-- either the over-the-ditch step between final welding and lowering in, or coating yards set up in the field.

The coating and wrapping of line pipe is extremely important to the prevention of leaks, and fusion bonded epoxy offers the optimum performance for this aspect of pipeline construction and operation. TransCanada plans to use this method of coating for the Keystone pipeline.

Cathodic protection is the other design feature employed to mitigate corrosion. Certain soil conditions can produce a situation in which an electrochemical reaction, i.e., current flow from an anode (the pipe) to the surrounding soil (the cathode), would occur, if not prohibited by the pipe coating or other protective means. The propensity for this condition will vary greatly along the pipeline, and will be quantified for all areas along the route. In some locations, sacrificial anodes may be installed to direct current flow away from the pipe; in others, rectifiers may neutralize the reaction. The soil conditions responsible for these conditions may change from time to time; hence an ongoing monitoring program will be employed and the cathodic protection system will be altered as conditions dictate.

TransCanada will also periodically run "smart pigs" through the system. These are instrumented devices which move through the pipeline with the flowing oil stream and identify the location and extent of any anomaly in the pipe wall, allowing for its repair long before it can become critical.

I'm concerned that many people may visualize the pipeline as comprising a series of flanged and bolted connections, or bell and spigot joints, with oil dripping from them undetected for long periods of time. While there is certainly nothing wrong with properly installed flanged fittings, the fact is that the welded steel pipeline will be a long, closed continuous tube with bolted connections only at pump stations, isolation valve sites, and certain monitoring locations. It will be a "tight line" operation, no set-off points or intermediate storage tanks along the route.

I've also heard concern voiced that roots would work themselves into the pipe and cause leaks, another indication that the concept of a welded steel pipeline is not understood. (It's doubtful that a tree or plant would seek moisture from an oil pipeline, in any case.)

Diluents and blending. At the Alexandria meeting, an attendee stated that he had been informed that a highly volatile and hazardous diluent would be mixed with the syncrude at the pipeline origin, then removed at the refinery and pumped back to Canada through another pipeline constructed alongside the crude oil line.

This is most certainly not true. In the first place, the cost of construction and operation of a second pipeline to return part of the stream would remove the project from economic feasibility.

What the TransCanada plan calls for is a simple blending operation, common in the oil industry. In fact, the feedstock of many refineries is a blend of one or more crude oils.

I do not know the properties of the TransCanada syncrude, but I have performed laboratory and pumping tests on earlier production of syncrude. It was a highly viscous fluid at ambient temperatures, making it difficult to pump long distances by pipeline. In this regard, it is no different from many conventional crude oils. South China Sea production is high in wax content; some asphaltine based Venezuelan crude oils exhibit high viscosity and pour point. In some cases these kinds of crude oil have been made "pipeline friendly" by flow improvers (essentially viscosity reducing agents), forming an emulsion with water, or heating the crude oil stream periodically as it moves down the pipeline. Flow improvers add to the cost of a project, emulsions result in lower refinery efficiency (as well as the additional cost of preparing the emulsion), and both capital and operating costs of "hot oil" pipelines are far higher than for more conventional systems.

The addition of less viscous crude oil, condensates, or other light ends to the syncrude is nothing more than a blending operation, common practice in oil field production. The entire stream will be processed by the refinery.

Other issues. Another item of public concern seems to be the crossing of existing pipelines. This is routinely accomplished during new construction in many parts of the United States, where a complex network of natural gas, refined product, and crude oil pipelines exists.

Highway and improved road crossings will be bored, not cut, minimizing interruption of traffic and eliminating surface repair. Burial depth will meet or exceed Code specifications.

I have enclosed a copy of a handbook, *Pipeline Construction*, published by the Petroleum Extension Service of the University of Texas. It includes a four-panel depiction of a typical pipeline construction spread.

I hope you find this information useful in your proceedings.

Sincerely,