



## Failure of Cap Screws on NPS 30 PN 100 Tilting Disc Check Valves

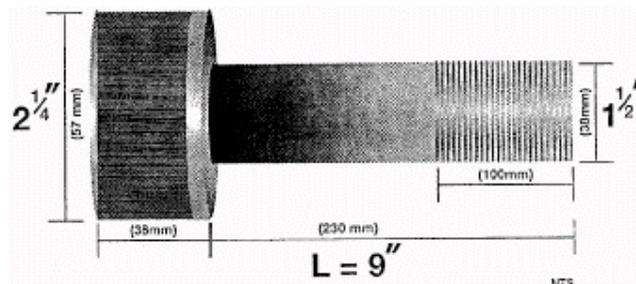
### Incident Description

In March 1997, a check valve located on pump station discharge piping failed resulting in a significant spill of crude oil. The failed check valve was located underground just downstream of the pump building. The leaking check valve resulted from the failure of several cap screws that are used to fasten the two pieces of its valve body together. The check valve was a NPS 30 PN 100 flange-by flange Tilting Disc Check Valve (complete with dashpot) manufactured by Dominion Engineering Works Ltd. in 1967. Later in 1997, another failure occurred at the same location involving the cap screws of an identical replacement check valve.

### Cause of the Incident

The cause of the incidents was hydrogen embrittlement of the valve cap screws. More specifically, embrittlement and fracture of the studs resulted from the presence of a susceptible material, a high tensile stress, and a source of hydrogen. The source of hydrogen was attributed to the cathodic protection system acting on the valve even though it was determined that the cathodic protection system was operating at normal levels at the time of the incidents. The cap screws did not have any protective coating applied to them making them susceptible to the diffusion of hydrogen in the material.

### Cap Screw



### Preventive Actions

- a) Pipeline Companies should determine if flange-by-flange Tilting Disc Check Valves manufactured by Dominion Engineering Works Ltd. exist on their pipeline systems.
- b) If so, the Pipeline Company should excavate and examine each of the valve's cap screws for hydrogen-related damage and make the necessary repairs.
- c) Pipeline Companies should consider examining similar types of installations on their systems for hydrogen-related damage (e.i. other buried bolted assemblies).

Note: The company to which these incidents occurred has initiated an action plan consisting of the excavation, inspection, necessary replacement and recoating of cap screws on their system. The new cap screws used to replace the damaged cap screws are ASTM A 320 L7 with rolled threads.