National Transportation Safety Board
Internal Inspection Factual
Bellingham, Washington
Accident DCA99-MP008

Three internal inspections were conducted in the 16" Olympic pipeline section which contains the rupture between 1991 and the time of the accident. The first was an inspection conducted by Tuboscope on November 18,1991 (Appendix 1) using a conventional resolution (Linalog Plus) magnetic flux leakage tool. According to the Tuboscope report, the instrument was properly set-up and calibrated prior to insertion into the pipeline and it functioned properly during the run. A Linalog Plus bulletin (Appendix 2) describes what results can be expected from Tuboscope's conventional resolution magnetic flux internal inspection tool. An independent evaluation of the Tuboscope instrument calibration was performed by an OPS consultant (Appendix 3) who confirmed that it was set-up properly for the inspection and performed satisfactorily. No defects or features were reported in the area of the eventual rupture by Tuboscope as a result of the November 1991 Linalog Plus inspection.

A second inspection was performed on March 18,1996 (Appendix 4) using the same type of Tuboscope tool. The Tuboscope report indicates that the instrument was properly set-up and calibrated prior to insertion into the pipeline and it functioned properly during the inspection. The OPS consultant's evaluation (Appendix 3) also confirmed that it was set-up and calibrated properly for the inspection run and performed satisfactorily. As a result of the March 18,1996, Tuboscope inspection, 20 defects with 20% or greater pit depth were reported to Olympic as well as 125 features. The maximum pit depth among the reported pipe defects indicated 47 % metal loss. The report states this is a repeat inspection and the data was compared to the previous Linalog Plus survey. One of the defects was reported at Tuboscope wheel count (wc) 844+16, approximately 14 feet downstream of the rupture location. The anomaly at wc 844+16 was classified as a "possible mill/mechanical" defect, 0.4 inch long having 23% wall thickness loss located at 1 o'clock on the pipe. A "possible mash" pipe feature report followed the defect which was reported to start 0.2 inches downstream of the start of the defect at the same Tuboscope wc station number. A "possible mill/mechanical" feature at wc 844+02 was reported in the area that subsequently ruptured with the Tuboscope evaluator's comment that it was a "possible wrinkle bend" which is a bend with one or more buckles in the pipe.

Two different sorts of 1996 flaw list data (Appendix 5) were provided by Olympic, one in order of PR Ratio[1] and another in order of increasing wc station numbers. On a copy of the Tuboscope flaw list dated 5/23/96 (labeled page 0000079), an Olympic engineering assistant (assistant) made notations comparing data between the 1991 survey with the 1996 report. No comments were recorded beside the possible mill/mechanical defect (at wc 844+16) listed 14 feet downstream of the eventual rupture location. On the defect detail printout provided by Olympic, in addition to the detail information on the 23% wall loss defect data, "possible mash" had been hand-written under the defect station location number.

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[1] **The Pressure Related Ratio (PR Ratio) considers the radial depth and axial length of each reported defect to provide an estimated pressure based upon the ANSI B31G pressure formula for the remaining strength of corroded pipelines. The calculation results are designed by Tuboscope to serve as a reference tool for the prioritization of physical defect investigations.**

As a result of a leak in a parallel 20" Olympic pipeline in the Ebey Slough area, a September 17, 1996, Washington Department of Ecology's (WDOE) administrative order DE 96CP-N269 (Appendix 6) required Olympic to, among other items, run a magnetic flux leakage tool through pipeline sections for which magnetic flux inspection data did not exist and submit an analysis upon completion of the run. This report was to explain the cause of all identified anomalies. Furthermore, the order stated that any significant anomalies that cannot be excused by examination of the data must be verified by field inspection. Olympic was also required to run a caliper tool through those pipeline sections where caliper tool data did not exist. Then Olympic was to prepare a comparative analysis identifying any discrepancies of caliper tool data and construction drawings for the entire system. Significant discrepancies were to be investigated and verified by field inspection which included excavation and examination of the anomaly.

On October 15, 1996, Olympic responded (Appendix 7) to the WDOE order. Item 1 of the WDOE order required a schedule for review and analysis of pipeline magnetic flux tool data for the entire pipeline system for potential anomalies similar to those found after the Ebey Slough spill which had been determined to be the result of a buckled pipe failure. Responding to Item 1, Olympic provided a list showing the magnetic flux inspections that had previously been performed on its pipeline system and the proposed years of future inspections. Olympic further responded that they voluntarily run a magnetic flux tool for the inspection of corrosion and other forms of metal loss anomalies, generally on a 5 year schedule. Olympic stated that the magnetic flux tool is not effective for the detection of dents and buckled pipe because these defects do not involve metal loss. Furthermore, Olympic stated that the magnetic flux tool very effectively pinpoints corrosion, scratches, gouges, and welds.

Regarding Item 2, within 30 days from the issuance of the order, Olympic was required to explain the cause of all identified anomalies in the magnetic flux internal inspection data analysis. Furthermore the WDOE required that anomalies that cannot be excused by examination of data must be verified by field inspection of the pipeline sections involved. Olympic responded that the length and depth of any anomaly is measured from data gathered by the inspection tool, then calculated in accordance with the B31.4 piping code, Olympic stated that its policy is to excavate and expose any anomaly, which would not meet the code criteria of the rated design. Olympic further stated, if any pipe exposed indicates an anomaly exceeding the code's criteria, repairs will be made to restore the pipe to design standards. The B31.4 piping code, 1992 revision, in effect at the time of the accident and when repairs were made following the 1996 inspection specifically states that the formula is only to be used for corrosion pitting. Under Section 451.6.2 (a)(1)-limits and disposition of defects, the code states that gouges and groves having a depth greater than 12 ½ % of the nominal wall thickness shall be removed or repaired. Olympic did not have a procedure for evaluating non-corrosion features[2] located during an internal inspection to determine whether to expose them for examination.

Item 3 required Olympic to submit a schedule for comparative analysis of caliper tool data and construction drawings for the entire pipeline system to identify discrepancies between them. Item 4 required a report identifying any discrepancies found between the caliper tool data and the

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[2] For example, non-corrosion features could be gouges identified by a magnetic flux inspection or dents from a geometry tool inspection.

pipeline field inspections. Regarding Items 3 and 4, Olympic reported that in 1993, Enduro improved their technology so that they could differentiate and locate buckles immediately adjacent to bends and fittings. Olympic asked them to review the data from the 1991 geometry inspection and provide an updated interpretation. Enduro determined that 4 elbows were suspect for buckling based on their analysis. All of the anomalies were evaluated to exist in the lower outside elbow. Upon excavating the anomalies, three of the four areas were confirmed to have buckles and were repaired The remainder of the 20-inch line was reviewed as well as the 14-inch line which had been inspected by Enduro and no other areas were determined to have buckling.

A caliper tool inspection of the 16-inch pipeline was made by Enduro on January 15,1997, to determine the geometrical condition of the pipeline and to specifically detect buckles in compliance with the WDOE order. The graphical data for this inspection was presented on a scale of 1-inch equals 250 feet of pipe. Enduro provided a report which included the Anomaly Confirmation Sheet (Appendix 9). In the area of the fbture rupture, Enduro interpreted a log indication as a girth weld and so made no comment. This was the same area identified by Tuboscope as a possible wrinkle bend. A correlation between the 1996 Tuboscope and 1997 Enduro logs is shown in the OPS consultant's report (Appendix 3) titled Smart Pig Data Analysis, Appendix D, page 2 of 3. The caliper tool reported an anomaly downstream of the rupture location as a 0.45 (inch) sharp defect[3] in its field report on Jan. 27, 1997 at Enduro station 843+72 (corrected in the Enduro anomaly Confirmation Sheet as station 843+69). This was the same location previously identified by Tuboscope at wheel count 844+16 as a possible mill/mechanical defect having 23% wall thickness loss followed by their feature report of a possible pipe mash.

On May 22,1997, Olympic further responded to Items 3 and 4 of the WDOE order by providing a schedule for completing the necessary inspection work. After reviewing the caliper tool inspection report for an additional 215 miles which was received on March 26,1997, Olympic began exposing various locations beginning in early April 1997. In the letter, Olympic reiterated their use of ASME B31.4 (1992 Edition) par. 451.6.2 (1) (2) (3) to analyze pipeline anomalies related to gouges, grooves, dents and corrosion. Further, they reported that they strictly follow the repair guidelines in 451.6.2 and they may also make repairs to lesser defects, depending on the anomaly. They noted that all lesser defects are evaluated for repair by a member of Olympic's engineering group who considers location, sharpness and appearance of the defect, location of the seam or joint welds, and other factors that influence stress at the location of the defect. Olympic fbrther stated that data obtained from the current excavation locations would be used to make a decision whether to continue or discontinue excavation of lessor defects.

Attached to the letter was a chart that showed the identified defects, the schedule, what was found where digs had already been made, and the repair with completion date, if excavated. The 0.45 total sharp defect at Enduro station 843+69 was scheduled to be investigated in May of 1997 with a footnote on the schedule that Olympic may investigate it if risk is justified by engineering opinion. Neither in the letter, nor in the schedule, did Olympic note that Tuboscope had identified a feature at wc 844+02 as a possible wrinkle bend. Olympic stated that they planned to submit a final table showing the *summary* of anomaly investigations and disposition

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[3] A sharp defect contains a reduction in pipe diameter within a 2 feet length of pipe per Enduro evaluation criteria. The reduction could be caused by, for example, pipe dents, bends, weld misalignment, or valves.

as soon as all work was complete which was scheduled for August 1,1997. On June 3,1997, Olympic faxed a copy of an updated chart of field investigationsto WDOE.

The Olympic dig sheet dated 7/97 (Appendix 10) for the area in proximity to the rupture contains comments by the engineering assistant who evaluated the data. Some general notes indicate that it is a difficult area to access and that this location was not inspected. None of the intemal inspection anomalies were excavated for inspection at the locations on this report. The engineering assistant completing the evaluation added some information under the entry for the Tuboscope intemal inspection "possible mill/mechanical" defect at wc 844+16 that was missing 23% of its wall thickness. Additional details of this defect included on this dig sheet indicate that it was 0.4 inch long, located 1 foot 6 inches from the weld and at the 1 o'clock position in a 23 foot long joint and that there was a possible mash of the pipe. Next to Tuboscope's "possible wrinkle bend" feature at wc 844+02, he wrote that it was a defect and also referenced Enduro station 843+69's 0.45 (inch) sharp defect[4]. In the general notes for the dig site he indicated that it was not inspected. He further noted that Tuboscope's 23% defect was "min. risk", indicating minimum risk, and further noted that the Enduro 0.45" sharp was " less than repairable". The last note after the initials RJK is that it is a difficult area to access.

The engineering assistant provided (See Appendix 11) a copy of the dig sheet to Olympic's construction supervisor so that excavation and inspection of the anomalies in the vicinity of the water treatment plant could be scheduled. The construction supervisor stated that he had one of his employees go to the site to check the location in anticipation of performing the excavation. This employee reported back to him that the location was too wet to perform the excavation at that time. When the construction supervisor reported this back to the engineering assistant, he was told they would go back and try again when it dried up. He said that no further action was taken to excavate the pipeline in this vicinity prior to the accident.

An article subsequentlyprovided by Olympic (Appendix 12) provides information they used for evaluation of gouges and dents. Olympic policy did not require using pipeline alignment maps or other pipeline records, such as pipeline diagrams' ofchanges (Appendix 13) which have information on foreign line crossing locations, in the evaluation of intemal pipeline inspection reports.

The required follow-up letter with disposition comments and details to WDOE was to have been made by Olympic in August 1997. The latest completion date in the summary chart dated March 1998 (Appendix 14) by Olympic indicates that the field excavation inspections were completed by November 6,1997. Olympic did not create correspondence supplying inspection information to WDOE after completion of the work. Olympic's updated information currently indicates that no field inspection of the pipeline had been made at wc 844+02 or wc 844+16.

Clifford Zimmerman 12/6/00 ACB 12/6/00 RJD 12/6/00

[4] The actual location of the Enduro station 843+69 sharp defect is approximately 14 feet downstream of the pipe failure, however, this is the data the engineering technician used to evaluate the Olympic dig information.

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