ALBERTA ENERGY AND UTILITIES BOARD
Calgary Alberta

SHELL CANADA LIMITED
TO ALLOW LINES 45 AND 46 OF THE CARBONDALE PIPELINE
TO RETURN TO SERVICE PENDING PUBLIC INQUIRY **Decision 98-16**
SECTION 43(5) HEARING **Application No. 980290**

1 INTRODUCTION

1.1 Background

The Alberta Energy and Utilities Board (EUB) issued Decision D 95-6 on 15 March 1995 approving Shell Canada Limited.'s (Shell) application to construct a steel pipeline (the Carbondale Pipeline), approximately 30 kilometres in length, designed to carry sour natural gas with a maximum H_2S content of 320 mols/kmol (32 per cent) from wells located in the upper Carbondale River region of southwest Alberta. Figure 1 shows the location of the pipeline and other relevant geographic points of interest in this matter.

The Carbondale Pipeline was commissioned in September 1995 to transport sour gas from three wells upstream from Junction J (see Figure 1). The three wells brought on stream in September 1995 were located at

- Lsd 7 of Section 20, Township 6, Range 3, West of the 5th Meridian (7-20 well)
- Lsd 12 of Section 9, Township 6, Range 3, West of the 5th Meridian (12-9 well)
- Lsd 6 of Section 12, Township 6, Range 3, West of the 5th Meridian (6-12 well)

Line 45 receives production from the 7-20 well and connects to Line 46 at the 12-9 well. Production is then transported to the 6-12 well tie in. From there, Line 53 transports the commingled effluent from the three wells to Junction J at Lsd 1 of Section 7, Township 6, Range 2, West of the 5th Meridian where Line 53 is then tied into Line 42.

On 18 December 1995, a failure on Line 42 was detected approximately 600 metres (m) downstream of Junction J at Lsd 13 of Section 5, Township 6, Range 2, West of the 5th Meridian. A perforation of 3 millimetre (mm) diameter had been created by internal pitting corrosion. The pipelines upstream and downstream from Junction J were shut-in pending investigation and repairs. Local area residents, Mr. Mike Judd and Dr. David and Jean Sheppard, requested a public hearing on the circumstances surrounding the leak. The EUB agreed to hold a hearing into the circumstances surrounding the failure of Line 42 and on 2 May 1996 the EUB allowed gas to be transported through Lines 45, 46, and 53 to an existing 114.3 mm pipeline which paralleled the failed Line 42. The hearing was eventually cancelled because the residents subsequently withdrew their objections to the start-up of Line 42. On 19 July 1996,

following a review of Shell's reports and commitments to certain operational procedures, the Board authorized the return to service of Line 42 downstream of Junction J.

The pipelines were operated until 3 September 1996, when Shell suspended operation of Lines 45, 46, and 53 pending reservoir stimulations of both upstream wells (7-20 and 12-9) to improve deliverability.

On 23 May 1997, the 7-20 and 12-9 wells were brought back on production and Lines 45, 46, and 53 were recommissioned. Certain repairs and replacement of sections of pipe were carried out during June and July 1997 on Lines 45, 46, and 53 as a result of internal corrosion detected by the use of internal inspection devices. The acronym for the device used by Shell is "IPCIT" which means Internal Pipeline Corrosion Inspection Tool On 30 July 1997, Line 53 was returned to service and production from the 6-12 well was transported to the Waterton plant. The 7-20 well was returned to production on 11 August 1997 and Lines 45 and 46 resumed service.

Over the period 15 - 18 August 1997, Lines 45 and 46 were being removed from service due to monitored corrosion indications at a test site. On 18 August 1997 a failure on Line 46 was discovered by a local rancher who noted the odour of sour gas and a dead cow and calf near the pipeline approximately five kilometres (km) upstream of Junction J. The 6-12 well was then shut in and Line 53 was removed from service.

Investigations revealed that the 18 August 1997 failure occurred at a girth weld which was one of several welds which had been part of the general repair program conducted by Shell during June and July 1997. Initial analysis of the failed piece of pipe determined that the failure was due to sulphide stress cracking at the weld. Further analysis of the faulty weld led to the conclusion that the following factors acted simultaneously to cause the failure:

- quenched weld area inducing high local hardness likely due to a wet, sloughing mud plug;
- incomplete weld penetration on root passes creating a potential crack initiating site;
- short pipe replacement length creating high stress when the pipe was heated and cooled during the welding process; and
- high sulphide environment reacting with the steel of the pipe to induce cracking.

Lines 42 and 53 were allowed to resume operations shortly after the second leak once it was determined that the failure mechanism was sulphide stress cracking and that these pipelines would

only be transporting gas with a very low hydrogen sulphide content from the 6-12 well. Investigation, reporting, and repair work was conducted by Shell from 18 August 1997 to December 1997.

After the second pipeline failure the EUB received requests from Dr. David and Jean Sheppard (the Sheppards') and Mr. Mike Judd to suspend the operation of the entire Carbondale Pipeline and conduct a public inquiry into its operation. The residents were concerned about the integrity of the pipeline and the potential impact on their safety. Shell objected to such a public inquiry. The EUB determined that a public inquiry was warranted and by letter dated 19 February 1998, informed the Sheppards', Mr. Judd and Shell of its decision. At the same time it authorized Shell to recommission Lines 45 and 46 subject to certain conditions :

- notification of the start-up to any residents within the Emergency Planning Zone of the pipelines and those in close proximity to Junction J;

- testing of the pipelines after six to seven weeks of normal operation to detect any ongoing corrosion; and

- notification of testing operations and results by Shell to the Board's staff, such findings to form part of the evidence at the public inquiry.

By letter dated 28 March 1998, Mr. Mike Judd applied to the EUB for a hearing under section 43(1) of the *Energy Resources Conservation Act*, to have the EUB reconsider and rescind its decision to allow Lines 45 and 46 to return to service. The Sheppards' supported the application. Shell argued against holding a hearing for this purpose.

In a decision dated 20 April 1998, the EUB determined that it would hold a hearing to decide whether it would confirm, vary, or rescind its order of 19 February 1998 allowing the pipelines to return to service. The parties agreed to argue the merits of the application based on the material before the EUB on 19 February 1998, followed by oral argument. The evidence before the EUB is identified in Appendix A.

1.2 **Hearing**

On 1 June 1998, the Board, consisting of Board Members F. J. Mink, P.Eng, Presiding Member, B. T. McManus, Q.C., and Acting Board Member K. G. Sharp, P.Eng., considered the application and heard arguments from all parties. The EUB acknowledged, with agreement from the parties, that two additional documents should be part of the record before the EUB on 19 February 1997. These documents were a letter from Shell to the EUB dated 22 February 1996 with enclosures, relating most notably to a time line of significant events and a summary of IPCIT inspection results and a letter from Shell to the EUB dated 26 April 1996.

THOSE WHO APPEARED AT THE HEARING

Principals and Representatives (Abbreviations used in Report)	Witnesses
M. Judd (Mr. Judd)	
N. Conrad	
Dr. D. Sheppard and J. Sheppard (the Sheppards')	
G. Fitch	
Shell Canada Limited (Shell)	
R. B. Low, Q.C. and B. Gilmour	
Alberta Energy and Utilities Board staff	
T. Donnelly	
S. Lee, P.Eng.	

2 ISSUE

The Board believes that the only issue to be considered is whether Lines 45 and 46 should be removed from service pending the public inquiry.

3 DISCUSSION

3.1 Views of Mike Judd

Mr. Judd owns and/or occupies one section of land located at Section 6, Township 6, Range 2, West of the 5th Meridian. The Carbondale Pipeline lies near the eastern and northern borders of the Judd lands and the family residence is located at Lsd 16 of Section 6, Township 6, Range 2, West of the 5th Meridian, approximately 100 m from the pipeline and 500 m from Junction J. A guide and outfitter business is operated by Mr. Judd from his property. He urged the EUB to rescind its decision of 19 February 1998 which allowed Lines 45 and 46 to return to sour gas service.

Mr. Judd maintained that the operating record confirmed that extraordinary corrosion is present in the whole of the Carbondale Pipeline and that this situation required an examination of the entire pipeline system, not a narrow focus on the two actual failures which occurred in December 1995 and August 1997. Mr. Judd argued that the material upon which the EUB based its 19 February 1998 decision failed to take into account the condition of the entire Carbondale

Pipeline system on the health and public safety risks likely to result from future operations of the system.

In support of his position, Mr. Judd stated that the corrosion rate causing the first leak on Line 42 was not foreseen by Shell's predictive model and the actual corrosivity was approximately five to seven times greater than forecasted. In connection with the second leak, which occurred on Line 46 upstream of Junction J, he noted that the pipeline was only in service from 5 May 1996 to 3 September 1996, and from 23 May 1997 to 13 June 1997, before it was suspended along with Line 45 as a result of the detection of pitting corrosion. Monitoring by Shell revealed corrosion indications in both pipelines during June and July 1997 necessitating the removal and repair of
18 segments of the pipeline. When Lines 45 and 46 did start up again on 11 August 1997 a failure occurred within two or three days.

Mr. Judd noted that both pipeline failures were not detected by the monitoring, inspection, or warning systems put in place by Shell, adding a greater level of risk to the residents' safety.

Mr. Judd asserted that a proper consideration of the risks to public safety and health that the Carbondale Pipeline might pose requires a broad examination of the operations and maintenance of the entire pipeline. To that end, he submitted that insufficient evidence had been provided by Shell to the Board. He stated that the protection of public health and safety are the gravest components of the public interest which the EUB is bound to consider in any decision. The EUB must give greater weight to the security of the public, especially those who live near the pipeline, than to Shell's right to transport its sour gas in the Carbondale Pipeline..

Mr. Judd argued that Shell has not shown that the Carbondale Pipeline can be operated without undue risks to public health and safety. To the contrary, he contended that the evidence before the EUB confirmed that the system as a whole is prone to failure. In Mr. Judd's view there was no relevant evidence or insufficient evidence relating to the integrity of the system from the perspective of future risks to the public's well being.

Mr. Judd further submitted that the EUB had recognized the difficulties with the Carbondale Pipeline system in its Decision 97-16 when it rejected the proposed Burmis pipeline which would have tied into the Carbondale system at Junction J. In that decision the EUB questioned the merit of adding new effluent to the pipeline when the ability of the Carbondale Pipeline to operate without incident for a significant period of time remained to be determined. He submitted that any return to service is contrary to and inconsistent with this earlier decision of the Board.

Finally, Mr. Judd stated that a Board decision allowing Lines 45 and 46 to return to service in advance of the holding of a public inquiry will result in the appearance that a number of issues relevant to the public inquiry have been prejudged.

3.2 **Views of The Sheppards'**

Dr. David and Jean Sheppard reside approximately 200 m northeast of Junction J. They expressed their concern about the safety of the Carbondale Pipeline after the first failure and reiterated their request for a public inquiry into the pipeline's operations after the second failure. Their view is that the Carbondale Pipeline poses undue risks to public health and safety.

The Sheppards' pointed out that one of the causes of the first failure on 18 December 1995 was the inadequate gas velocities in the pipeline caused by significant gas production decline rates in wells 7-20 and 9-12. They submitted that the evidence showed that the wells' production rates had remained problematic since December 1995. They argued that the EUB should rescind its decision to allow Lines 45 and 46 to return to service because there was no evidence before the EUB on 19 February 1998 that the 7-20 and 12-9 wells could be produced at rates that would ensure adequate velocities in the pipeline to control corrosion. Further, they submitted that the EUB had cogent evidence before it that Lines 45 and 46 were experiencing continuing internal corrosion and on-going wall loss at unacceptable rates.

The Sheppards' contended that the evidence before the EUB established conclusively that there was significant continuing corrosion and wall loss from existing operations. Wall loss of up to 60 per cent was noted in the investigation into the first failure of 18 December 1995. Shell's IPCIT tests in 1996 showed seven isolated pits with maximum depth of 21 per cent on Line 45. No additional verification of the nature of this pitting was conducted by Shell, leading the Sheppards' to believe that it was likely that the pitting exceeded the stated depth of 21 per cent. They further argued that the IPCIT test results conducted after the first leak demonstrated that the inspection device was travelling too fast in a majority of sections of pipe to yield reliable results and that the actual amount of wall loss could be greater.

Lines 45 and 46 operated from 5 May 1996 to 3 September 1996. The Sheppards' stated that no inspection results were available for that period. The Sheppards' also submitted that Lines 45 and 46 were recommissioned on 23 May 1997, operated for 21 days and were then shut-in because IPCIT inspection results revealed wall loss of 30 per cent – 45 per cent on seventeen sections of pipe and 70 per cent on one section of pipe for Line 46. Wall loss of 40 per cent and 30 per cent on two sections of Line 45 were also detected by the testing. Removal and repair of these sections of pipe were conducted by Shell during the period June/July 1997. The Sheppards' observed that the June 1997 corrosion inspection results on both Lines 45 and 46 showed an increase of wall loss from the earlier inspection of April 1996.

The Sheppards' noted that Lines 45 and 46 were returned to service to transport sour gas from the 7-20 well for only three days before they were shut-in because monitoring of the pipeline had detected corrosion indications and hydrate formation in Lines 45 and 46.
The Sheppards' submitted that there was uncontradicted evidence before the EUB showing undue, continuing internal corrosion on Lines 45 and 46. They argued that the evidence also established that the corrosion control program initiated by Shell after the first pipeline failure on 18 December 1995, was ineffective.

3.3 **Views of Shell**

Shell requested that the EUB confirm its decision of 19 February 1998 allowing Lines 45 and 46 to remain in service. Shell submitted that its operation, maintenance, and monitoring of the Carbondale Pipeline is proper, safe, and adequate to address any reasonable concerns about undue risks to public health and safety presented by the pipeline.

Shell stated that the cause of the first leak was thoroughly investigated; the combined characteristics of the production and flow regime in the pipeline were determined; and the appropriate operating, maintenance, and inspection program was implemented to mitigate the original problem. The EUB approved its analysis and protocol for avoiding similar leaks in the future and allowed the pipelines to return to service on 2 May 1996. The Carbondale Pipeline has not experienced a similar failure since the first leak.

With respect to the cause of the second leak at a girth weld, Shell stated that the simultaneous confluence of three factors occurred to create the leak: mechanical force in the weld, high hardness of weld, and hydrogen charging of the weld. Appropriate construction and repair procedures have been implemented to prevent such a weld failure in the future. Shell submitted that foreseeable risks in Lines 45 and 46 have been adequately provided against.

In response to the Sheppards' contention that insufficient gas velocity in the pipeline has not been addressed properly, Shell relies on its Maintenance Reference Plan which compels a closure of the pipeline when volumes of gas in the line fall below a certain level.

Shell acknowledged that the nature of sour gas pipelines was to wear out in service. However, it stated that with the appropriate operating, maintenance, and inspection programs in place, including removal and replacement of sections showing undue pitting, the Carbondale pipeline is being operated in a safe manner imposing no undue risks to human health, safety, and the environment.

Shell refuted the view that the words "too fast" on the summary of inspection reports meant that the results of that inspection were understated. It pointed out that there was no evidence to support that conclusion. Further, it noted that the IPCIT recordings after the second leak in August 1997 actually exaggerated the depth of pitting in all but three sections of pipeline when the sections of pipe were removed and examined. Shell concluded that it has been overly cautious in its analysis of test data and subsequent remedial efforts.

Shell also maintained that the system is not subject to systemic weakness as advanced by Mr. Judd. Shell acknowledged the reasons for the two failures and submitted that it has implemented programs to mitigate, detect, and remedy corrosion before further failures occur.

Shell also disagreed with the Sheppards' interpretation of the 1996 IPCIT reading which led them to submit that strong evidence of continuous corrosion exists along certain sections. Shell pointed out that photographs taken of the pipe after the first leak did not show continuous corrosion.

3.4 **Views of the Board**

The Board believes the issue at this hearing is to determine whether Lines 45 and 46 should be allowed to operate pending the outcome of a public inquiry into the general operation of the entire Carbondale Pipeline. In the Board=s view, the pivotal questions in determining that issue are whether the operation of the pipeline represents a material risk to the safety of the public and to what extent operating the pipeline could be of benefit to the pending public inquiry in the long term.

The Board maintains that an operator of any oil and gas facility must be in a position to satisfy the Board, both prior to and subsequent to approval, that a facility can be operated safely. Accordingly, the Board must be satisfied that the northern portion of the Carbondale Pipeline can be operated properly without undue risk to public health or the environment pending the public inquiry.

The Board accepts that some corrosion will likely occur in steel pipelines which transport sour gas. For that reason, the Board believes that the design criteria, the corrosion management program implemented by Shell, the use of suitable material characteristics and flow regime, the schedule of electronic inspections, the use of appropriate inhibitors and on-going inspection, monitoring and analysis must take this fact into account and ultimately provide assurance that the pipeline can be operated without undue risk.

As a result of the leak on the pipeline in December of 1995, it was recognized that portions of the pipeline system were experiencing corrosion at higher than expected rates and therefore an extensive investigation was required into the causal mechanism. The EUB required Shell to enhance its established monitoring program such that sufficient time was available to respond to problems associated with increased corrosion rates. Along with an enhanced monitoring program (i.e., frequent internal inspection tool runs) other operating enhancements were built into the routine operations of the pipeline system. These included the use of a more suitable corrosion inhibitor and more frequent batch application of the corrosion inhibitor, and imposition of a minimum velocity in the pipeline to remove any liquid or solids build-up that could be a source for corrosion commencement.

The Board notes that despite these enhancements to Shell=s operating practice, significant corrosion was still being detected in the pipeline segments upstream of Junction J on Lines 45 and 46, as well as Line 53. In June and July of 1997 Shell initiated a repair program on these pipelines. It is the Board=s view that this action was taken prudently and demonstrates a level of vigilance to detect advanced corrosion that should alleviate the risk of failures in the short term. Unlike with Line 42, where the first leak occurred, the Board does not have the results of similar testing and analytic data for Lines 45 and 46, as well as Line 53.

In order to make the inquiry meaningful the Board believes as much data as possible regarding the integrity of the entire Carbondale Pipeline should be available to allow a thorough examination of its present and future operation. The Board believes the additional operative data as a result of the start-up and continuous operation of Lines 45 and 46, as well as Line 53, would provide more definitive evidence on the response of the pipeline to real time operating conditions. The Board expects inspection tool runs would indicate pitting rates that would allow the Board a better opportunity to gauge the corrosion management protocol. Notwithstanding that need for this data, the Board must be satisfied that operation of the pipelines will not compromise the safety of the public.

In the Board=s view, the principal risk that a premature failure could occur comes from the operating environment in the pipeline and the reliability of the detection system in place that could identify potential problem areas and be used to prevent such a failure. The time interval during which the pipelines would be operating prior to the final disposition of the public inquiry is also a factor influencing the Board=s decision.

As noted by the interveners, a key element for safe operation of the pipeline is the flow rate of products transported in the pipeline. The Board notes that Shell has committed to maintain adequate velocity within the pipeline to eliminate hold up of liquids and will shut-in the pipeline if flow rates fall below minimum levels.

Respecting the concerns that inappropriate speed of the inspection device makes Shell=s IPCIT data suspect or fails to reveal alarming rates of corrosion, the Board is satisfied that subsequent runs yielded satisfactory correlation to verify actual pit sizes and orientation. Accordingly, the Board accepts that the data is representative of the characteristics in the pipeline.

The Board also notes that after the first leak, Shell adopted a more rigorous monitoring schedule that should provide advance warning of corrosion. In addition, the Board believes that the time interval during which the pipeline would be in operation prior to the final disposition regarding the integrity of the pipeline system should be relatively short.

In allowing Lines 45 and 46 to start-up, the Board is not prejudging any issue that will be the focus of the public inquiry; rather, it is determining that in the near term, pending the more wide ranging scope of the public inquiry into the entire pipeline=s operations, it is satisfied that the Carbondale Pipeline can be operated with a reasonable and adequate level of safety and that in so operating, valuable data will be made available for the public inquiry concerning its long term viability to operate safely.

4 DECISION

The Board has considered carefully, the evidence submitted and the arguments made at this section 43(5) hearing to review and vary its 19 February 1998 decision concerning the operation of Lines 45 and 46 of Shell=s Carbondale Pipeline. The Board is satisfied that its original decision to allow Line 45 and 46 to return to service was appropriate and confirms that these pipelines will be allowed to remain in operation within the criteria set by the EUB pending its final disposition on the long term operation of the Carbondale Pipelines.

Dated at Calgary, Alberta on 17 September 1998.

<Original signed by>

F. J. Mink, P.Eng.
Presiding Member

<Original signed by>

B. T. McManus, Q.C.
Board Member

<Original signed by>

K. G. Sharp, P.Eng.
Acting Board Member

APPENDIX A

First Leak - 18 December 1995

Canspec metallurgical report dated 16 January 1996

Shell preliminary failure investigation report, dated 4 March 1996

EUB letter to Shell re: Review of Report (results and questions) dated 25 March 1996

Shell recommissioning plans (maintenance reference plans), dated 16 April 1996

EUB letter to Shell re: line decommissioning and addressing concerns dated 2 May 1996

Shell summary report, dated 14 November 1996

Second Leak - 18 August 1997

Shell weld failure investigation updated, dated 22 September 1997

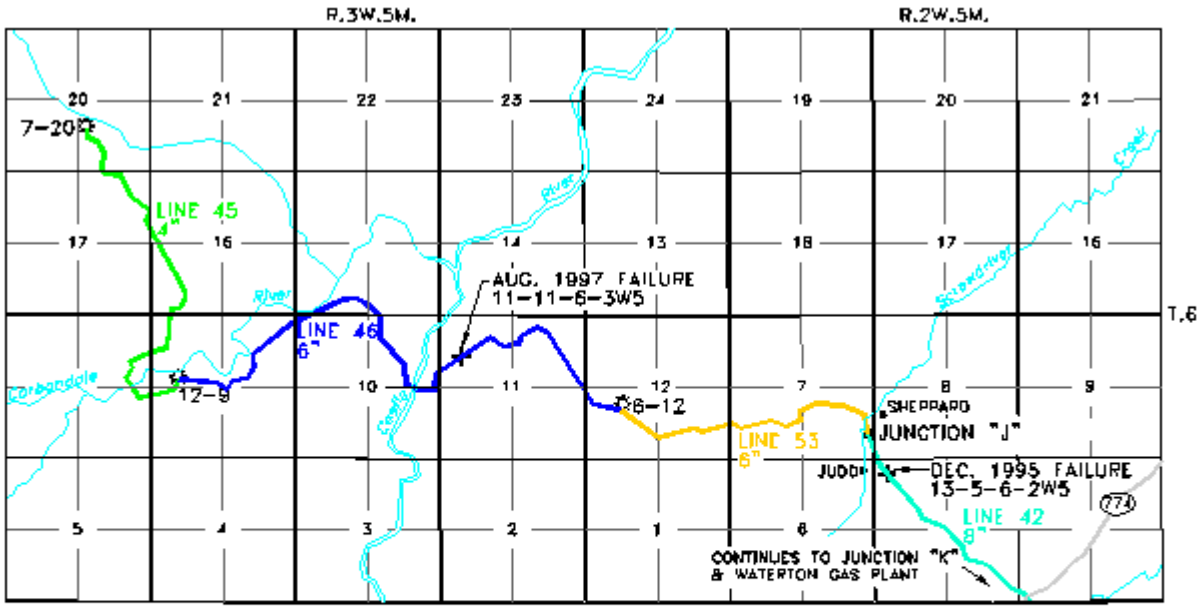
Shell flowline incident report dated October 1997

Shell pipeline report (resumption request), dated 29 October 1997

Shell IPCIT results on 6 inch line dated 6 November 1997

Shell maintenance reference plans dated 26 February 1998

(Board acknowledges specific MRP's prior to its February decision.)



LEGEND
✕ POINT OF FAILURE

Shell Carbondale **Pipeline** – Junction "J"

Decision 98-16