Imperial Oil

2006
Casing Integrity Report.
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Alberta Energy and Utilities Board
640 - 5th Avenue SW
Calgary, Alberta
T2P 3G4

Attention: Mr. Ken Schuldhaus, P. Eng.
In Situ Section Leader
Resources Applications Group

Mr. Schuldhaus:

Re: 2006 Annual Casing Integrity Report

This report is being issued to satisfy the conditions of EUB Decision 99-22, Condition #9 and clause 6.2 of AEUB Approval 8558.

This is the seventh annual report to be submitted, and as such is intended to build on the information that was included in the previous report, with focus on 2006 performance.

Imperial Oil firmly believes that the comprehensive casing integrity program that is in place at Cold Lake provides the necessary operating practices and procedures to ensure integrity within our operations.

Should you wish to meet and discuss the contents of this report further, please do not hesitate to contact me at (403) 237-3427 or Troy Shandro at (780) 639-5171

Sincerely,

Mark Taylor, P. Eng.
Cold Lake Reservoir and
Subsurface Engineering Manager

cc. Don Hennessey Field Centre Team Leader, AEUB - Bonnyville

2006 Annual Casing Integrity Report

Introduction

Pursuant to the requirements of AEUB Decision 99-22, Condition #9 and clause 6.2 of AEUB Approval 8558, Imperial hereby submits the 2006 annual summary report on casing integrity and remediation efforts.

This report is the seventh annual report to be submitted, and as such builds on the information that was included in the previous reports, with focus on 2006 performance.

For the purpose of these annual reports, a casing failure is defined as a break or crack in the production casing that results in the well's inability to contain pressure.

2006 Summary

A summary of the 2006 casing failures at Cold Lake is provided below:

- 1 near surface casing failure
- 26 intermediate depth casing failures
  - 25 primary commercial intermediate failures (11 operational, 14 casing integrity check)
  - 1 multi-well secondary commercial intermediate failure (operational)
- 70 Clearwater (producing zone) casing failures

Casing Failure Classification

Casing failures have been classified according to the following three depth intervals:

- Near surface (0 - 25 mTVD)
- Intermediate wellbore including the Quaternary, Colorado group, and Grand Rapids formation (25 - 420 mTVD)
- Production zone, at the interface between the Clearwater Formation and the Grand Rapids Formation or lower

Undetected near surface and intermediate well failures have potential for environmental consequence due to potential aquifer contamination or breach to surface. Production zone (Clearwater) failures only affect the serviceability of the well, and thus the recovery from the Clearwater reservoir. The existing casing integrity program for Cold Lake was designed to address the concerns associated with the near surface and intermediate wellbore intervals, and was not intended to deal with the failures within the production zone.

For the purpose of the report, a primary failure is defined as being limited to a single well failure. A secondary (or multi-well) failure occurs when fluid loss from a primary failure results in immediate adjacent well failures.

Environmental Consequence Assessment for Casing Failures

Imperial Oil's Environmental Consequence Matrix was updated to reflect improved understanding of environmental impact caused by surface and intermediate casing failures and to apply learnings since the original matrix was created in 2001. This improved matrix classifies failures based primarily upon fluid loss, aquifer contact, remediation efforts, and failure depth (geologic zone). Consequence levels are assigned jointly by environmental and engineering personnel utilizing the descriptions provided in Table 1. Clearwater top failures do not have an adverse environmental impact, and therefore this matrix is not applied to that category.

Table 1: Environmental Consequence Matrix for Casing Failures

Consequence Level	Environmental Consequence Description
Level 0	- Failure occurred within the bedrock with fluid loss below the typical threshold required to cause a multi-well failure (approximately 1000 – 5000 m^3 produced fluid, dependant on proximity of wellbores at failure depth) - Failure occurred within the Glacial Till, but only released inert fluid (e.g. N_2 gas) or minimal produced fluid not requiring remediation
Level 1	- Failure occurred within the bedrock with fluid loss above the typical threshold required to cause a multi-well failure (approximately 1000 – 5000 m^3 produced fluid, dependant on proximity of wellbores at failure depth) - Failure released fluid into the Glacial Till and there is low potential of the fluid migrating to a freshwater aquifer (i.e. volume released from failure is low, or the aquitard layer is thick)
Level 2	- Failure with fluid release to surface or fresh water aquifer requiring longer term remediation efforts

Note: Bedrock is defined as solid rock that underlies unconsolidated surface material (i.e. Bedrock includes the Lea Park and/or Colorado Group and lower formations).

Near Surface Failures

Historic consequence levels associated with near surface casing failures since 1996 are displayed in Figure 1. All near surface failures, except H01-03 (1996), were assessed at a Level 0 environmental consequence, including the near surface failure in 2006 at J03-20 (detected during a pre-steam casing integrity check resulting in negligible environmental impact). As highlighted in previous annual reports, the H01-03 surface failure that occurred in 1996 was assessed at a Level 2 consequence due to an estimated fluid release of 4700 m^3 at surface.

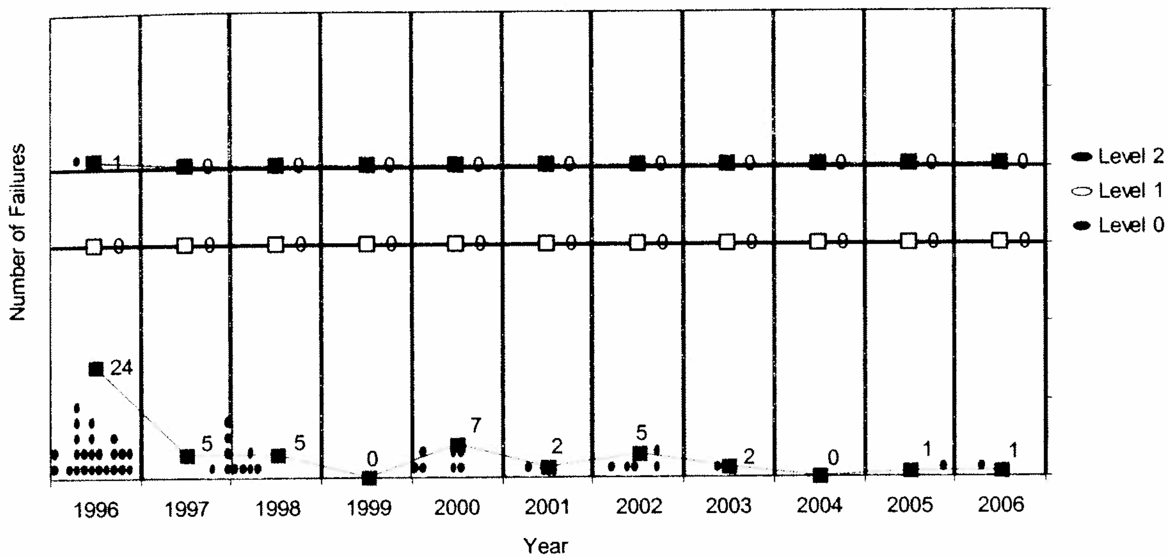

Figure 1: Cold Lake Surface Failures by Consequence Level

Intermediate Depth Failures

Historic consequence levels associated with intermediate casing failures since 1996 are displayed in Figure 2. Two (of the 26) intermediate failures that occurred in 2006 were assessed at higher than Level 0 environmental consequence.

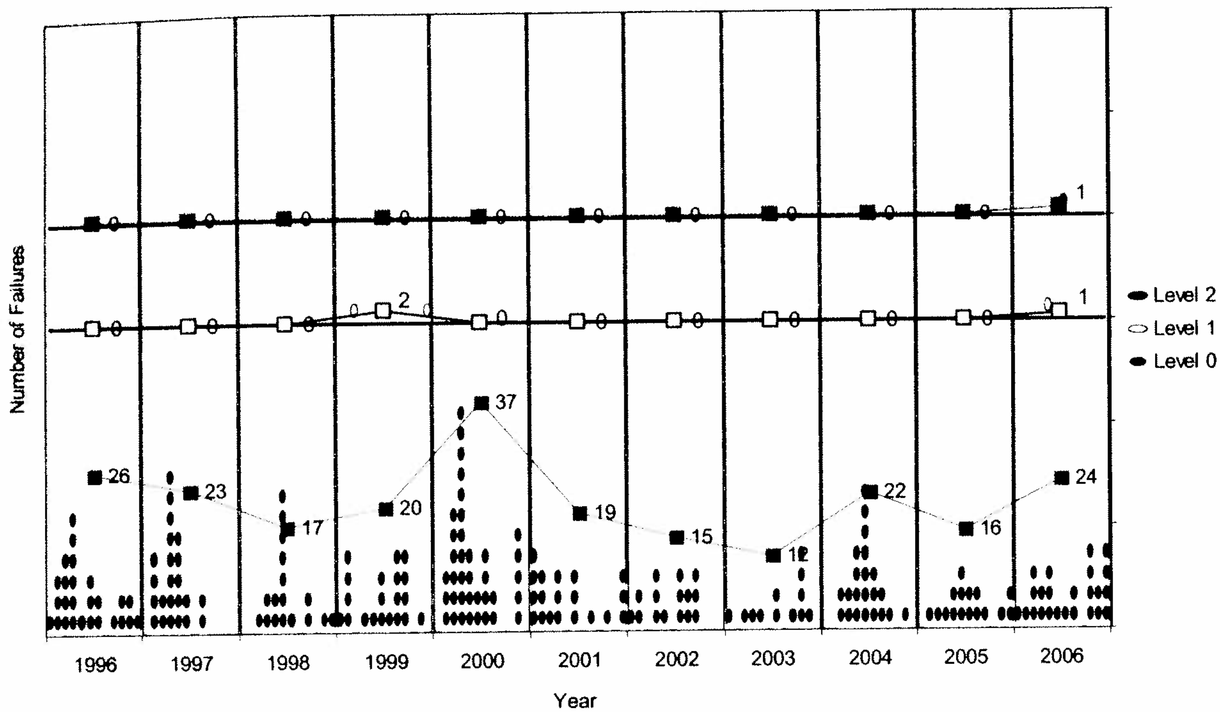

Figure 2: Cold Lake Intermediate Failures by Consequence Level

T09-01 & T09-07

The T09-01 intermediate casing failure detected in May, 2006 was assessed at a Level 1 consequence due to resulting fluid loss into the bedrock that was above the threshold to cause a multi-well failure. It was estimated that the primary failure, T09-01, released 6000 m^3 fluid (primarily steam) into the Colorado group, which resulted in the secondary intermediate failure at T09-07. T09-07 released an estimated 900 m^3 fluid (primarily produced water) therefore was assessed at a Level 0 consequence since fluid loss was less than 1000 m^3. Since both releases were contained within the Colorado group, no adverse environmental impact was deemed to occur.

H39-H04

The H39-H04 failure detected in July, 2006 was assessed at a Level 2 environmental consequence due to aquifer contact. It was estimated that H39-H04 released 3200 – 5400 m^3 produced fluid (approximately 25% bitumen) into the Glacial Till. A summary of the actions taken in the delineation, quantification, evaluation, and remediation stages of Imperial Oil's incident response was summarized in the H39-H04 Casing Failure Investigation letter submitted to AENV and the EUB on December 19, 2006.

As highlighted in previous annual reports, prior to 2006 only two intermediate failures were assessed above the Level 0 environmental consequence level. Both of these failures, H15-10 and E10-12, occurred in 1999 and were assessed at a Level 1 consequence. The H15-10 intermediate failure resulted in an estimated release of 200 m^3 produced fluid into the Empress 1 aquifer which was successfully remediated. The E10-12 failure resulted in an estimated release of 1700 m^3 which was contained within the Colorado group.

Near Surface Casing Integrity (0-25 mTVD)

The primary mechanism for near surface casing failures is external corrosion. Minor wellhead packing leaks and surface water run-off collect in the conductor - production casing annulus forming a corrosion cell. Water typically accumulates in the conductor annulus due to cement slumping (after primary cementing) or cement degradation over time.

Corrosion inspection logs (electromagnetic flux leakage) and casing pressure tests are completed as part of the ongoing casing integrity program. Wells identified with corrosion concerns are either pressure tested to ensure suitability for service, repaired, or taken out of steam service. Improved primary cementing practices for new wells enhance the ability to achieve and maintain cement tops at surface. However, if the cement quality is not adequate in the production casing, the well will be repaired or not utilized for CSS service. Wells that have cement tops near surface are topped up with bentonite during the first steam cycle.

The number of commercial surface failures by year in Cold Lake is displayed in Figure 3. Since 1991, 81 commercial wells have failed in the top 25m of the wellbore, including the surface failure detected at J03-20 in 2006 during a pre-steam casing integrity check. Details on this failure are shown in Table 2. The peak failure rate in 1996 corresponds to failures identified through pre-steam casing integrity checks implemented as part of the casing integrity program. In addition, a further 107 wells have either been proactively repaired or taken out of steam service due to excessive wall loss. It can be seen from Figure 3 that the number of near surface failures has been reduced significantly since 1996, indicating the effectiveness of Cold Lake's cementing, top-up, and casing integrity operating practices. These existing operating practices have also been successful in selectively removing damaged wells from active operations.

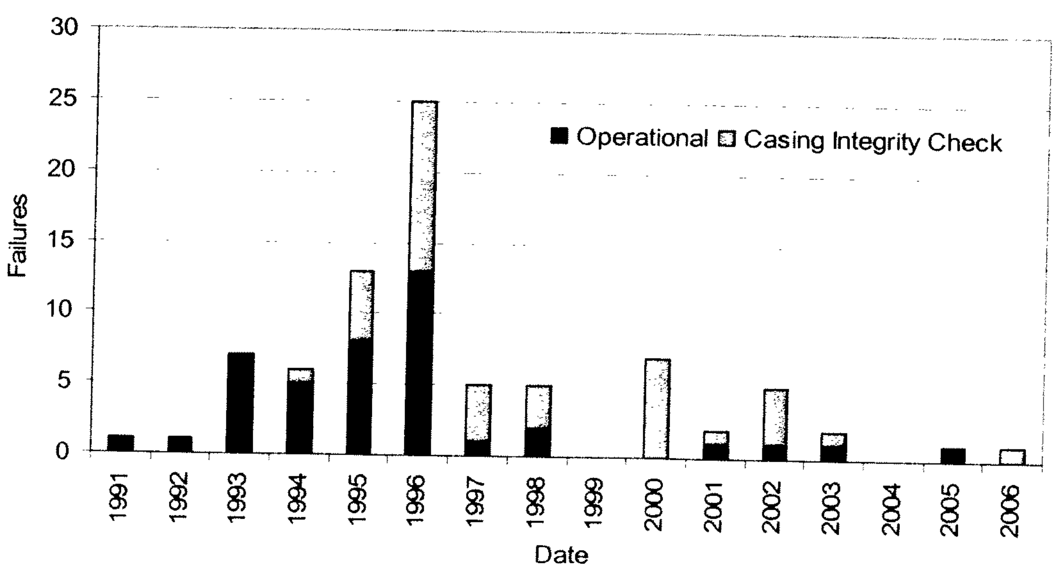

Figure 3: Commercial Surface Failures by Year

Table 2: 2006 Surface Casing Failure Summary

No.	Official Well Name	Well Licence #	Date Failure Detected	Failure Depth (mKB)	Cycle #	Casing Details: Size (mm)	Weight (kg/m)	Grade	Connection	Multiple Failures	Detection Method
1	ESSO 84 J3-20 COLDLK 3-22-65-4	109728	2-Apr-06	6.2	10	177.8	34.2	MN-80	OSBTC	N	CI

Near Surface Corrosion Study

A study was completed in 2005 to evaluate external corrosion rates and the effectiveness of applicable operating practices in Cold Lake. Corrosion inspection logs analyzed back to 1996 confirmed that corrosion rates had significantly decreased since the implementation of bentonite top-ups in 1996, and in most cases corrosion rates were negligible at the original primary cement top depth. This confirmed that the practices implemented to mitigate corrosion at the primary cement top had been highly successful. The investigation also revealed that a new corrosion cell had developed close to surface in a limited number of wells as a result of cement / bentonite top-up over time. Further analysis yielded that the corrosion rate was low in this scenario, and failure rates were significantly below those seen in older wells at the primary cement top.

As a result, Imperial Oil's conductor top-up practice was updated to reflect increased understanding of corrosion rates and to implement strong maintenance and inspection requirements. Current standards now require wells to be topped-up during cycle 1 steam, and for all operating wells to be maintained on an annual basis.

Intermediate Casing Integrity

The scope of this document includes intermediate failures that have occurred in wells with L-80 or IK-55 casing (also referred to as 'commercial' design), and does not include early casing designs, such as SOO-95. There were no failures in wells of earlier casing design in CSS operation in 2006.

As described in previous documents submitted to the EUB, including Cold Lake Expansion Project - Volume 1: Project Description (February, 1997), the primary cause of intermediate wellbore failures has been determined to be environmental cracking, with fatigue considered to be a contributing factor.

Several steps have been taken to reduce the number of failures associated with these mechanisms. Improved casing connection design to reduce steam seepage on new wells and better steam water alkalinity control reduce the occurrence of stress corrosion cracking failures. Tannin-to-caustic ratio management for boiler feed water was introduced in January, 2003 to further minimize failures due to caustic stress corrosion cracking. In addition, nitrogen purging is used to reduce the presence of H_2S in the casing - tubing annulus during shut-in periods, helping to mitigate the occurrence of failures due to sulfide stress corrosion cracking.

Since the implementation of the casing integrity operating practices in 1996, a total of 197 primary intermediate casing failures have been detected in wells with the L-80 or IK-55 casing designs. The consequences associated with these failures are summarized below:

- One multi-well failure has occurred since 1996 (T09-01).
- 2 (of 197) intermediate failures required aquifer remediation (H15-10, H39-H04).
- 137 of these failures (approximately 70%) were identified during pre-steam casing integrity checks.
- 275 additional wells were taken out of steam service or repaired due to intermediate impairments or excessive deformation.

The primary intermediate failure frequency for L-80 or IK-55 casing design is provided below in Figure 4. The data is divided into early (1-4), mid (5-7), and late (8-12) cycle classifications, and within each classification failure frequency is determined based on the number of failures divided by the total number of wells within each classification.

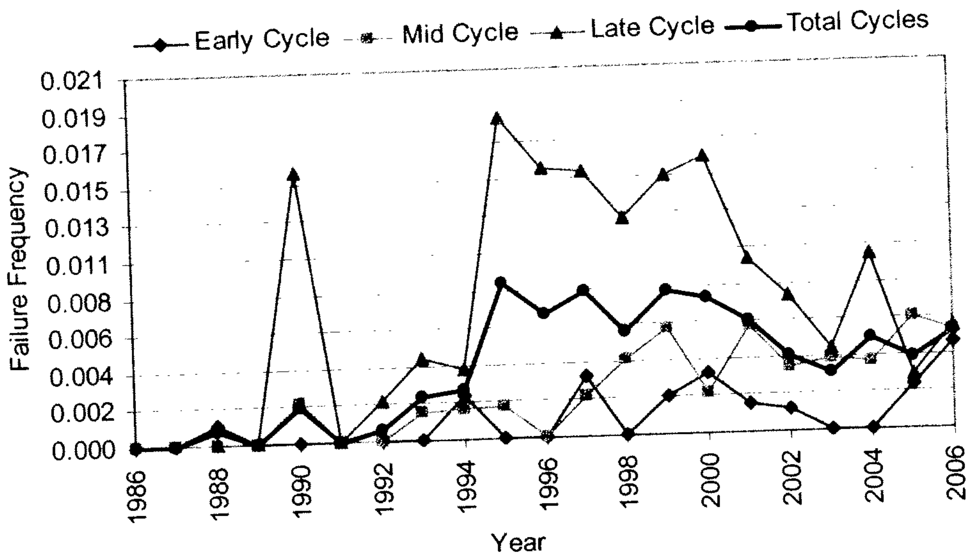

Figure 4: Primary Intermediate Commercial Failure Frequency Classified by Cycle

As illustrated in Figure 4, the failure frequency for later cycle wells has been historically higher than for early and mid cycle wells, but has declined since 1995 due to the combination of removing wells with impaired casing from steam service and effectively controlling the wellbore environment.

As expected, the early and mid cycle failure frequency remains low, however it has increased since 2004. As a result of the T09 multi-well failure and the increasing failure frequency of early and mid cycle wells, Imperial Oil has initiated an investigation to review all aspects of the casing integrity process. From a systematic elimination of variables, data gathering efforts, and down-hole diagnostic work, the predominant failure mechanism has been identified as sulfide stress corrosion cracking (SSCC). Although the investigation is on-going, interim actions have being implemented as described below:

- Modifications to wellbore environment control standards (increased nitrogen purging)
- Enhancements to casing failure detection systems (integration of flow and passive seismic)
- Increased casing check frequency for 'upgraded commercial' design (metal-to-metal connections) to correspond with 'commercial new' design.
- Increased emergency response capabilities by increasing on-site hematite inventory from 100 to 350 tonnes, as well as the addition of a second pre-mix tank.

Although the early cycle failure frequency has increased since 2004, the total failure frequency has remained relatively constant since 2002, and has reduced significantly since the implementation of the casing integrity program in 1996. This reduction in total failure frequency, in combination with the associated environmental consequences shown in Figure 2, indicates that improvements made in the areas of design, installation, operation, detection, and response are yielding an overall benefit to Cold Lake Operations.

The number of primary intermediate casing failures in Cold Lake is summarized in Figure 5 below, and indicates that the number of early cycle failures has historically been lower than mid and late cycle failures.

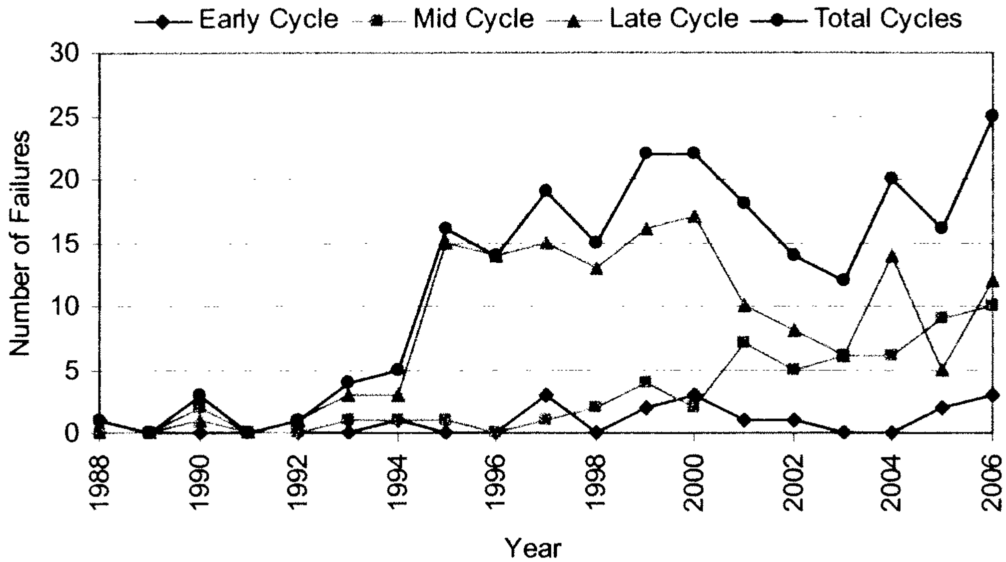

Figure 5: Primary Intermediate Commercial Failures Classified by Cycle

Failure detection method by cycle is displayed in Figures 6, 7 and 8. An operational failure is defined as a failure detected with DFP (Delta Flow & Pressure), Nitrogen Soak, or Passive Seismic. A casing integrity check failure is defined as a failure detected as part of the pre-steam casing integrity process. Although no correlation can be made for early cycle wells due to the limited data size, Figures 7 and 8 illustrate that the pre-steam casing integrity process detects a significant portion (approximately 70%) of the failures for mid and late cycles.

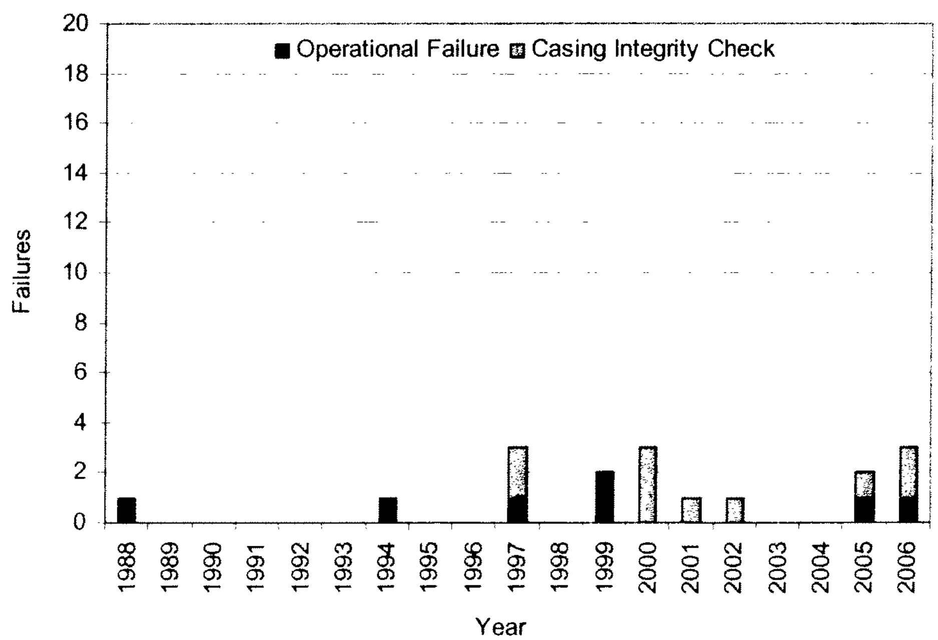

Figure 6: Early Cycle Primary Intermediate Commercial Failures by Year

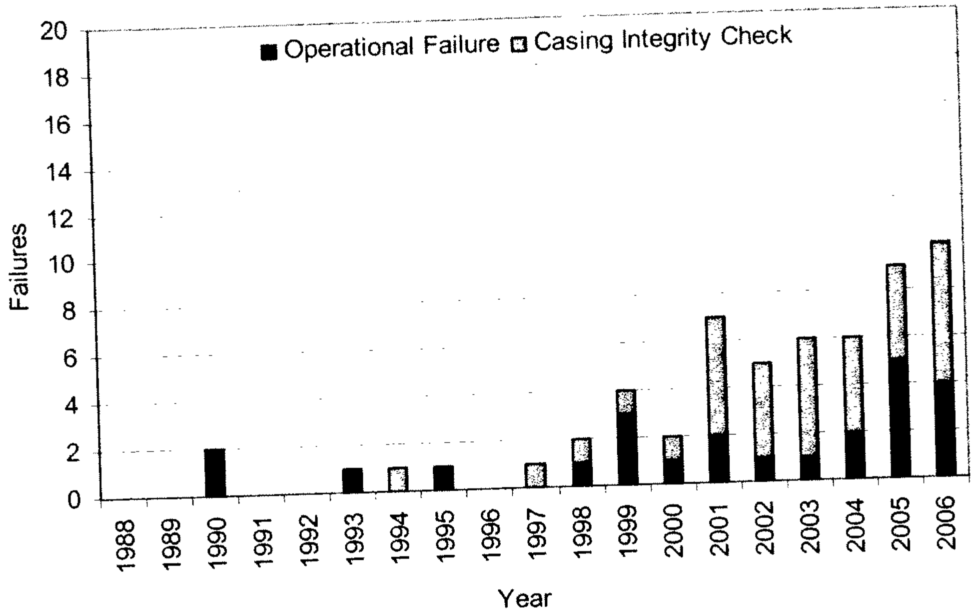

Figure 7: Mid Cycle Primary Intermediate Commercial Failures by Year

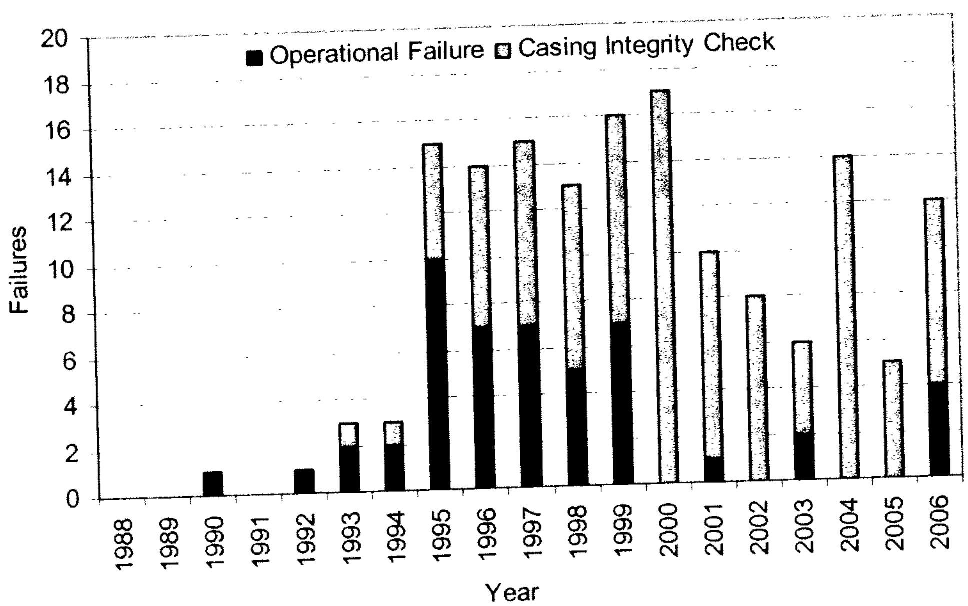

Figure 8: Late Cycle Primary Intermediate Commercial Failures by Year

Details on the intermediate casing failures that were detected in 2006 are provided in Table 3.

Table 3: 2006 Intermediate Casing Failure Summary

No.	Official Well Name	Well Licence #	Date Failure Detected	Failure Depth (mTVD)	Cycle #	Casing Details				Multiple Failures	Detection Method
						Size (mm)	Weight (kg/m)	Grade	Connection		
1	IMP 01 T10-15 COLDLK 16-30-64-3	248826	01/06/06	253.6	4	177.8	34.2	L-80	NSCCM	N	CI Check
2	IMP 00 T03-10 COLDLK 6-32-64-3	236996	02/18/06	266.6	5	177.8	34.2	L-80	NSCCM	N	CI Check
3	IMP 93 D63-11 COLDLK 11-36-64-4	158394	03/09/06	238.9	8	177.8	34.2	L-80	OSBTC	N	Operational
4	ESSO 84 J6-2 COLDLK 9-22-65-4	108975	03/24/06	269.5	6	177.8	34.2	MN-80	OSBTC	N	CI Check
5	ESSO 84 J3-12 COLDLK 3-22-65-4	109720	03/29/06	299.4	11	177.8	34.2	MN-80	OSBTC	N	CI Check
6	IMP 03 V09-08 COLDLK 4-35-64-3	291586	04/18/06	228.0	3	177.8	34.2	L-80	NSCCM	N	CI Check
7	IMP 93 D63-5 COLDLK 10-36-64-4	158400	04/20/06	280.0	8	177.8	34.2	L-80	OSBTC	N	Operational
8	IMP 01 T09-07 COLDLK 3-32-64-3	248723	05/08/06	267.4	5	177.8	34.2	L-80	NSCCM	N	Operational
9	IMP 97 F01-14 COLDLK 3-18-65-3	205045	05/09/06	244.0	5	177.8	34.2	L-80	OSBTC	N	CI Check
10	IMP 01 T09-01 COLDLK 4-32-64-3	248717	05/09/06	278.0	5	177.8	34.2	L-80	NSCCM	Y	Operational
11	IMP 99 G01-24COLDLK 12-9-65-3	221383	05/24/06	230.0	7	177.8	34.2	L-80	OSBTC	N	Operational
12	ESSO 84 H4-5 COLDLK 13-22-65-4	111144	06/11/06	265.5	10	177.8	34.2	L-80	OSBTC	N	CI Check
13	IMP 93 D63-17 COLDLK 6-36-64-4	158388	07/11/06	290.3	8	177.8	34.2	L-80	OSBTC	N	Operational
14	IMP 04 H39-04 COLD LK 1-10-66-4	311886	07/24/06	79.7	2	177.8	34.2	L-80	QB2	N	Operational
15	IMP 95 H16-07 COLDLK 11-27-65-4	176412	08/08/06	298.1	7	177.8	34.2	IK-55	QB2	N	CI Check
16	IMP 96 E09-11 COLDLK 3-36-64-4	188927	08/19/06	229.0	9	177.8	34.2	L-80	OSBTC	N	Operational
17	ESSO 83 B4-11 COLDLK 16-14-65-4	103495	10/17/06	285.4	10	177.8	34.2	L-80	OSBTC	N	CI Check
18	ESSO 87 D12-9 COLDLK 9-3-65-4	127345	10/26/06	291.0	9	177.8	34.2	L-80	OSBTC	N	CI Check
19	IMP 00 T04-19 COLDLK 1-5-65-3	236978	10/31/06	241.5	6	177.8	34.2	L-80	NSCCM	N	Operational
20	IMP 01 Y31-06 COLDLK 12-31-64-3	256921	10/31/06	249.7	5	177.8	34.2	L-80	NSCCM	N	Operational
21	ESSO 86 D10-11 COLDLK 1-10-65-4	123728	11/01/06	223.0	9	177.8	34.2	L-80	OSBTC	N	CI Check
22	IMP 00 D67-12 COLDLK 13-25-64-4	241761	11/07/06	236.0	6	177.8	34.2	L-80	NSCCM	N	Operational
23	ESSO 85 D1-6 COLDLK 4-13-65-4	114405	12/07/06	390.0	12	177.8	34.2	L-80	OSBTC	N	CI Check
24	ESSO 87 C4-1 COLDLK 13-18-65-3	126278	12/17/06	237.3	10	177.8	34.2	N-80	OSBTC	N	CI Check
25	ESSO 87 C5-5 COLDLK 13-18-65-3	126615	12/17/06	223.4	10	177.8	34.2	N-80	OSBTC	N	CI Check
26	IMP 01 Y16-16 COLDLK 16-36-64-4	256846	12/21/06	255.0	6	177.8	34.2	L-80	NSCCM	N	Operational

Operational - DFP, N2 Process, Passive Seismic

Passive Seismic monitoring is successful in supplementing the existing intermediate depth casing failure detection systems of DFP and Nitrogen Soak, and providing monitoring during production operations. The primary purpose of Passive Seismic systems at Cold Lake is to monitor for fluid incursion events into the Colorado group. However, the casing-to-rock interaction when a casing string breaks is unique compared to other natural shear events in the rock, thus making it possible to detect casing failures as well.

Clearwater Casing Integrity

Formation movement is the primary mechanism for Clearwater (producing zone) casing failures. As a result of the CSS process, shear stresses develop which results in slip along structurally weak planes existing at the Clearwater / Grand Rapids interface. As this shear is localized, there is no impact on intermediate casing integrity. There is no evidence that Clearwater failures cause, or are related to other intermediate depth or near surface casing failures. Although there is no adverse environmental impact, serviceability of the well and thus Clearwater recovery, can be restricted. The number of Clearwater casing failures at Cold Lake is displayed in Figure 9 below. Details on the Clearwater casing failures are provided in Table 4.

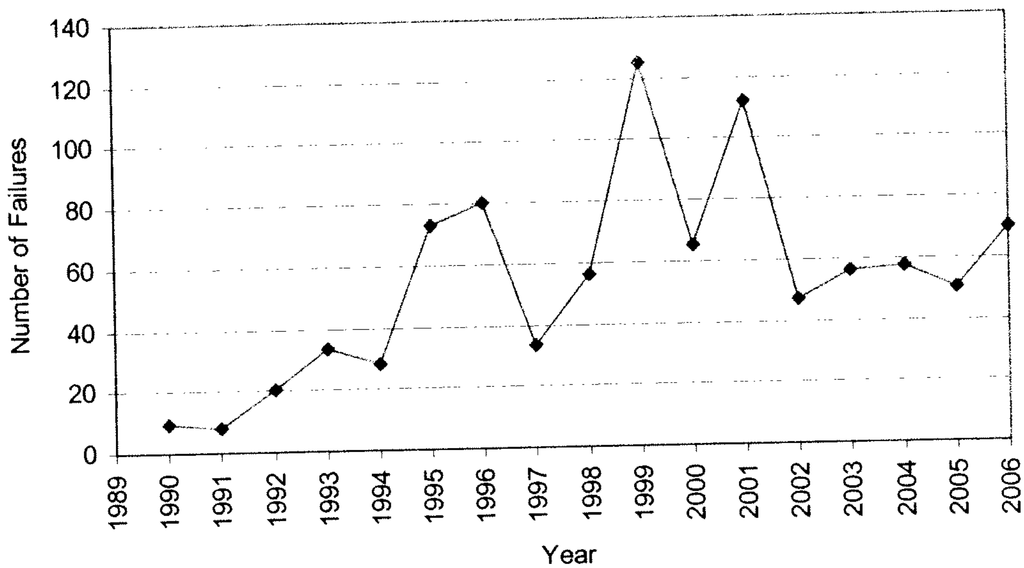

Figure 9: Clearwater Failures by Year

Passive Seismic systems are also used to detect Clearwater top casing failures even though the acoustic energy generated by a casing failure at large distances from the monitoring well can be attenuated. Although detection capabilities are lower since the signal to noise ratio is reduced at large distances, Passive Seismic will continue to be used to monitor for Clearwater top casing failures.

Table 4: 2006 Clearwater Casing Failure Summary

No.	Official Well Name	Well Licence #	Date Failure Detected	Failure Depth (mTVD)	Cycle #	Casing Details				Multiple Failures
						Size (mm)	Weight (kg/m)	Grade	Connection	
1	IMP 99 G01-29COLDLK 12-9-65-3	221391	01/04/06	425.0	6	177.8	34.2	L-80	OSBTC	N
2	IMP 99 G01-23COLDLK 12-9-65-3	221382	01/13/06	425.2	6	177.8	34.2	L-80	OSBTC	N
3	IMP 01 T07-04 COLDLK 14-28-64-3	248841	01/20/06	478.6	4	177.8	34.2	L-80	NSCCM	N
4	IMP 03 E01-07 COLDLK 7-12-65-4	291798	02/09/06	419.7	3	177.8	34.2	L-80	NSCCM	N
5	IMP 03 E05-15 COLDLK 7-1-65-4	287870	02/11/06	442.0	3	177.8	34.2	L-80	QB2	N
6	IMP 03 E05-16 COLDLK 7-1-65-4	287871	02/21/06	432.0	3	177.8	34.2	L-80	QB2	N
7	IMP 00 T03-10 COLDLK 6-32-64-3	236996	02/21/06	476.1	5	177.8	34.2	L-80	NSCCM	N
8	IMP 03 E05-07 COLDLK 7-1-65-4	287862	02/23/06	438.0	3	177.8	34.2	L-80	QB2	N
9	IMP 01 T09-13 COLDLK 2-32-64-3	248732	02/23/06	484.5	4	177.8	34.2	L-80	NSCCM	N
10	IMP 00 T03-05 COLDLK 6-32-64-3	236853	03/01/06	474.7	5	177.8	34.2	L-80	NSCCM	N
11	IMP 02 T12-21 COLDLK 7-29-64-3	268229	03/05/06	466.4	4	177.8	34.2	L-80	NSCCM	N
12	IMP 01 T09-08 COLDLK 3-32-64-3	248724	03/06/06	484..9	4	177.8	34.2	L-80	NSCCM	N
13	IMP 00 T03-17 COLDLK 2-32-64-3	237003	03/13/06	479.9	5	177.8	34.2	L-80	NSCCM	N
14	IMP 96 E07-12 COLDLK 15-36-64-4	189071	03/16/06	446.9	7	177.8	34.2	L-80	OSBTC	N
15	IMP 99 G01-06COLDLK 9-8-65-3	221362	03/16/06	427.3	6	177.8	34.2	L-80	OSBTC	N
16	IMP 01 U03-04 COLDLK 10-4-65-3	253364	03/16/06	455.5	4	177.8	34.2	L-80	NSCCM	N
17	IMP 03 E05-17 COLDLK 8-1-65-4	287872	03/21/06	432.0	4	177.8	34.2	L-80	QB2	N
18	IMP 03 E04-05 COLDLK 16-1-65-4	289293	03/27/06	426.3	1	177.8	34.2	L-80	QB2	N
19	ESSO 84 J7-10 COLDLK 16-16-65-4	112648	03/27/06	424.7	10	177.8	34.2	N-80	OSBTC	N
20	IMP 95 H26-13 COLDLK 2-3-66-4	179207	03/28/06	428.8	7	177.8	34.2	L-80	OSBTC	N
21	IMP 99 Y34-15 COLDLK 10-31-64-3	224602	03/28/06	451.9	7	177.8	34.2	L-80	NSCCM	N
22	IMP 04 H46-15 COLD LK 12-3-66-4	314349	04/07/06	409.7	1	177.8	34.2	L-80	QB2	N
23	IMP 97 F01-24 COLDLK 2-18-65-3	205055	05/01/06	418.5	5	177.8	34.2	L-80	OSBTC	N
24	IMP 01 U03-01 COLDLK 15-4-65-3	253360	05/01/06	454.8	4	177.8	34.2	L-80	NSCCM	N
25	IMP 99 Y36-02 COLDLK 11-31-64-3	224557	05/01/06	476.1	7	177.8	34.2	L-80	SWNA	N
26	IMP 95 H18-07 COLDLK 9-27-65-4	177525	05/04/06	415.1	8	177.8	34.2	IK-55	QB2	N
27	IMP 99 Y36-07 COLDLK 11-31-64-3	224560	05/04/06	459.1	7	177.8	34.2	L-80	SWNA	N
28	IMP 99 Y36-10 COLDLK 7-31-64-3	224564	05/07/06	462.2	7	177.8	34.2	L-80	SWNA	N
29	IMP 96 L11-30 COLDLK 12-28-65-4	191763	05/08/06	417.5	8	177.8	34.2	L-80	OSBTC	N
30	IMP 99 Y36-13 COLDLK 6-31-64-3	224567	05/16/06	471.7	7	177.8	34.2	L-80	SWNA	N
31	ESSO 85 D22-16 COLDLK 3-11-65-4	115057	05/26/06	417.4	11	177.8	34.2	N-80	OSBTC	N
32	IMP 97 F04-18 COLDLK 12-17-65-3	210806	05/26/06	420.0	7	177.8	34.2	L-80	OSBTC	N
33	IMP 96 H25-09 COLDLK 13-34-65-4	181187	06/05/06	419.0	7	177.8	34.2	L-80	OSBTC	N
34	IMP 95 H16-16 COLDLK 6-27-65-4	176407	06/07/06	421.5	7	177.8	34.2	IK-55	QB2	N
35	IMP 95 H23-09 COLDLK 14-34-65-4	180102	06/07/06	421.6	7	177.8	34.2	IK-55	QB2	N
36	IMP 99 Y34-09 COLDLK 15-31-64-3	224589	06/14/06	448.9	7	177.8	34.2	L-80	NSCCM	N
37	IMP 99 Y34-11 COLDLK 15-31-64-3	224595	06/18/06	462.8	7	177.8	34.2	L-80	NSCCM	N
38	IMP 03 E05-18 COLDLK 8-1-65-4	287873	06/20/06	422.0	4	177.8	34.2	L-80	QB2	N
39	IMP 01 U03-03 COLDLK 10-4-65-3	253363	06/20/06	455.6	4	177.8	34.2	L-80	NSCCM	N
40	IMP 03 E05-09 COLDLK 8-1-65-4	287864	06/23/06	429.2	4	177.8	34.2	L-80	QB2	N
41	IMP 01 T07-10 COLDLK 14-28-64-3	248837	06/25/06	480.2	4	177.8	34.2	L-80	NSCCM	N
42	IMP 96 E07-07 COLDLK 15-36-64-4	189058	06/28/06	435.5	7	177.8	34.2	L-80	OSBTC	N
43	IMP 03 E02-07 COLDLK 4-7-65-3	291550	07/04/06	415.2	2	177.8	34.2	N-80	NSCCM	N
44	IMP 96 E07-04 COLDLK 16-36-64-4	189063	07/09/06	416.4	7	177.8	34.2	L-80	OSBTC	N
45	IMP 00 T06-02 COLDLK 1-6-65-3	237343	07/25/06	453.2	6	177.8	34.2	L-80	NSCCM	N
46	IMP 01 V01-21 COLDLK 11-34-64-3	254047	08/01/06	478.9	4	177.8	34.2	L-80	NSCCM	N
47	ESSO 84 B6-4 COLDLK 1-24-65-4	110237	08/31/06	434.0	12	177.8	34.2	N-80	OSBTC	N
48	IMP 01 Y16-10 COLDLK 13-31-64-3	256871	09/08/06	454.8	5	177.8	34.2	L-80	NSCCM	N
49	ESSO 84 B6-9 COLDLK 16-13-65-4	110242	09/09/06	444.0	11	177.8	34.2	N-80	OSBTC	N
50	IMP 03 E05-08 COLDLK 8-1-65-4	287863	09/09/06	422.0	4	177.8	34.2	L-80	QB2	N
51	IMP 95 H18-09 COLDLK 9-27-65-4	177522	09/09/06	421.0	8	177.8	34.2	IK-55	QB2	N
52	IMP 01 Y16-08 COLDLK 4-6-65-3	256869	09/14/06	454.3	5	177.8	34.2	L-80	NSCCM	N
53	ESSO 83 B4-1 COLDLK 1-23-65-4	103496	09/21/06	430.8	11	177.8	34.2	N-80	OSBTC	N
54	IMP 03 E02-19 COLDLK 1-12-65-4	291782	09/21/06	433.2	4	177.8	34.2	N-80	NSCCM	N
55	IMP 01 T09-05 COLDLK 13-29-64-3	248721	09/27/06	481.5	5	177.8	34.2	L-80	NSCCM	N
56	IMP 95 H18-15 COLDLK 9-27-65-4	177530	10/01/06	415.0	7	177.8	34.2	IK-55	QB2	N
57	IMP 01 T09-02 COLDLK 4-32-64-3	248718	11/08/06	482.5	5	177.8	34.2	L-80	NSCCM	N
58	ESSO 84 B6-13 COLDLK 15-13-65-4	110272	11/03/06	430.0	11	177.8	34.2	N-80	OSBTC	N
59	ESSO 84 B6-1 COLDLK 2-24-65-4	110234	11/09/06	435.0	12	177.8	34.2	N-80	OSBTC	N
60	ESSO 85 D3-19 COLDLK 10-11-65-4	115821	11/24/06	434.0	12	177.8	34.2	N-80	OSBTC	N
61	ESSO 85 D2-13 COLDLK 8-11-65-4	114526	11/29/06	420.2	10	177.8	34.2	N-80	OSBTC	N
62	IMP 02 L08-18 COLDLK 6-29-65-4	276372	12/01/06	424.7	5	177.8	34.2	L-80	QB2	N
63	IMP 00 T05-10 COLDLK 8-31-64-3	236683	12/02/06	465.0	6	177.8	34.2	L-80	NSCCM	N

Summary of 2006 Activities

The comprehensive casing integrity program (focused on design, installation, operation, detection and response) initiated at Cold Lake in 1996 provides the necessary operating practices and procedures to ensure operations integrity.

- The Environmental Consequence Matrix has been updated to reflect improved understanding of environmental impact caused by surface and intermediate casing failures and to apply learnings since the original matrix was created in 2001. This will allow for a thorough assessment of environmental impact due to near surface and intermediate casing failures with regards to casing integrity performance.
- Bentonite top-ups have proven effective at managing external casing corrosion on Cold Lake CSS wells, and upgraded top-up maintenance and monitoring practices have been implemented to ensure continued performance.
- As a result of the T09-01 multi-well failure and increased early and mid cycle failure frequencies, an investigation was initiated to review all aspects of the casing integrity process. From a systematic elimination of variables, data gathering efforts, and down-hole diagnostic work, the predominant failure mechanism is identified as sulfide stress corrosion cracking (SSCC). Although the investigation is on-going, several interim actions have been implemented based on findings to date.
- Superior well control capabilities have facilitated quick and efficient response to casing failures during the high-pressure portion of the cycle. In 2006 Imperial Oil's on-site hematite inventory was increased from 100 to 350 tonnes, and an additional pre-mix tank was added to on-site inventory.

Continued Proven Practices

- Pre-steam casing integrity checks are effective in the proactive identification of casing deformations and failures prior to placing wells on steam.
- Nitrogen purging is effective in eliminating the corrosive environment in the wellbore, thus reducing the occurrence of sulfide stress corrosion cracking failures during the soak portion of the cycle.
- Tannin-to-caustic ratio specification for boiler feed water is an effective method for reducing failures due to caustic stress corrosion cracking.
- DFP and Nitrogen Soak monitoring programs are effective in the early detection of a potential casing failure.
- In addition to the primary casing failure detection monitoring systems of DFP and Nitrogen Soak, Passive Seismic monitoring is successful in confirming intermediate casing failures in the Colorado Shales, and in improving understanding of Clearwater top failures.