

ALBERTA ENERGY AND UTILITIES BOARD

Calgary Alberta

APPLICATION TO AMEND APPROVAL NO. 3950

IMPERIAL OIL RESOURCES LIMITED

COLD LAKE PRODUCTION PROJECT

SOUTH MASKWA/LEMING LAKE DEVELOPMENT

Addendum to Decision 96-3

Application No. 950185

1 INTRODUCTION

1.1 Background

Approval No. 3950 was issued to Imperial Oil Resources Limited (Imperial) in September 1983 for commercial development of the Clearwater oil sands deposit using cyclic steam stimulation (CSS). The approved development area for the project, commonly referred to as the Cold Lake Production Project (CLPP), is shown in Figure 1. The approval covers development phases 1 to 10 and allows for production of up to 18 000 cubic metres (m^3) per day of crude bitumen. The current commercial project consists of two operating areas, Maskwa and Mahihkan, each with its own steam generation and production processing facilities. Imperial also operates two pilot projects, Leming and May, adjacent to CLPP, where CSS and other bitumen recovery technologies have been tested and developed since the mid-1960s. Imperial currently operates over 2000 wells using CSS at the commercial and pilot projects. Steam injection pressures up to 12 megapascals (MPa) and temperatures up to 325°C Celsius are used at the Cold Lake operations.

In February 1995, four surface releases of steam and fluids occurred at T Pad at Imperial's Leming project. Casing failures at six wells caused the releases, the furthest some 400 metres (m) from the surface pad location. The total volume released was approximately 55 000 m^3 of solids and fluids, primarily water with a small amount of bitumen. After conducting a detailed investigation into the cause of the failures, Imperial maintained the primary casing failure was caused by stress corrosion cracking in the connections, which eventually failed because of mechanical overload. The primary failure resulted in the release of high pressure steam into the shales of the Colorado group, between the Fish Scale and White Specks markers, which caused secondary failures in five adjacent wells and the resulting release to surface. Metallurgical analysis also confirmed that sulphide stress cracking (SSC) occurred at T Pad. Imperial concluded in its report that conditions which cause SSC are likely to occur at certain times during the life of most wells at Cold Lake.

In January 1994, a similar incident occurred at AA Pad at the Leming project. A total of 14 casing failures occurred, which resulted in the release of approximately 8000 m^3 of solids and fluids to surface.

1.2 Application and Interventions

Imperial applied to the Alberta Energy and Utilities Board (the Board), pursuant to section 14 of the Oil Sands Conservation Act, for an amendment to Approval No. 3950 to allow the use of a combination of directional and horizontal wells to access the oil sand reserves beneath Leming Lake. The development is proposed for Section 34, Township 64, Range 4, and Sections 2, 3, and 11 of Township 65, Range 4, West of the 4th Meridian (Figure 1). The proposed development would use conventional directional CSS wells to access as much of the resource as possible from near-shore pads located within the 100 m set-back from the historical high water mark of Leming Lake. Additionally, horizontal wells would be used to reach those parts of the reservoir that are not accessible with conventional methods. Imperial requested approval of five near-shore pads (Figure 2) for the drilling of 92 directional and 4 horizontal wells.

Interventions opposing the application were filed by Mr. Duckett and the local Stop and Tell Our Politicians Society (STOP). Mr. Duckett is the holder of a registered trapline in the proposed development area (Figure 1) and his concerns related to impacts on his lifestyle and environmental impacts of the proposed development. STOP is an environmental group comprised primarily of people living in the Cold Lake area. STOP raised a number of concerns relating to well casing failures and to the environmental impacts of the proposed project.

Letters in support of the application were filed by the mayors of the Towns of Grand Centre, Bonnyville, and Cold Lake, in addition to the Bonnyville and District Chamber of Commerce. There were no representatives present to speak to these submissions at the hearing. Mr. W. Lucey, on behalf of the Confederation of Regions Party, filed a letter in opposition to the project but did not appear at the hearing.

1.3 Hearing

The application was considered at a public hearing in Grand Centre, Alberta, on 13 and 14 February 1996 before Board Members F. J. Mink, P.Eng., N. W. MacDonald, P.Eng., and J. D. Dilay, P.Eng.

THOSE WHO APPEARED AT THE HEARING

**Principals and Representatives
(Abbreviations Used in Report)**

Imperial Oil Resources Limited (Imperial)
D. Davies

Witnesses

R. J. Ottenbreit, P.Eng.
M. D. Taylor, P.Eng.
G. T. Milne, P.Eng.
G. G. Silgard
H. M. Shield, P.Geol.
A. J. Kennedy, Ph.D., P.Biol.

THOSE WHO APPEARED AT THE HEARING

**Principals and Representatives
(Abbreviations Used in Report)**

Witnesses

Stop and Tell Our Politicians Society (STOP)
S. A. Ulfsten

S. A. Ulfsten

Grant Duckett
J. Wiebe

G. Duckett

Alberta Energy and Utilities Board (EUB)
S. L. Wilson, P.Eng.
N. F. Lord, C.E.T.
B. A. Austin, P.Geol.
R. King
H. Nychkalo

The Board, in Decision 96-3 dated 11 April 1996, approved the application subject to certain conditions. Decision 96-3 is included as Appendix 1. This addendum to Decision 96-3 provides the reasons for the 11 April 1996 decision.

2 ISSUES

The Board believes the issues related to the application to be:

- ! the need for the amendment,
- ! technical considerations, and
- ! environmental and social considerations.

3 NEED FOR THE AMENDMENT

3.1 Views of Imperial

Imperial noted that the South Maskwa/Leming Lake area is within the defined project area as approved in 1983, and therefore, Imperial has an existing scheme approval to develop the resources under Leming Lake. The applicant argued that the issue is whether the existing scheme approval should be amended to allow Imperial to develop the South Maskwa/Leming Lake Area in the manner proposed in the subject application.

Imperial submitted that this proposal represents the best available development opportunity of the remaining resources on its lease due to the high quality of the resource and its proximity to existing operations. It maintained that it recognized this opportunity for some time, but accessing the bitumen resource was not feasible using only conventional directional drilling technology, given the environmental challenges of drilling under Leming Lake. Imperial stated that advances in horizontal drilling has enabled it to bring this proposal forward. It believed that the proposed development option was the best balance between achieving good resource recovery and providing adequate environmental protection.

The applicant stated that the immediate development of the resource beneath Leming Lake is required to optimize resource conservation. It initiated development around the perimeter of Leming Lake in 1986. It added four additional pads in 1993 and saw the proposed development as merely an extension of the existing development. On the basis of its experience, Imperial believed that concurrent depletion planning is very important in optimizing Cold Lake resource recovery. It maintained that development of the area beneath Leming Lake at this time will improve the ultimate recovery of both the existing surrounding operation and the proposed new development by managing the boundaries between the new and old pads. As well, the Maskwa operating area needs productivity maintenance pads in order to make efficient use of steam generation and processing facilities. If it is not possible to develop the Leming Lake area now, Imperial plans to move forward with the development in another part of the commercial area.

3.2 Views of the Interveners

The interveners did not comment on the need for the proposed development.

3.3 Views of the Board

The Board notes that the area under consideration is included in the defined project area of Approval No. 3950 as approved in 1983 and, subject to other concerns, is satisfied that Imperial has the right to develop the reserves under the lake. The Board also agrees that the primary matter for consideration is the method which Imperial has proposed to use to develop the resource beneath the lake.

The Board accepts Imperial's interpretation that the Leming Lake area contains some of the highest quality resource not yet developed in the Maskwa area. Furthermore, the Board acknowledges Imperial's need for productivity maintenance drilling to make efficient use of existing facilities.

With the existing pads around Leming Lake being in an advanced stage of depletion, the Board agrees with Imperial's argument regarding the importance of concurrent depletion and the impact that a delay in the development would have on resource recovery.

The Board concludes that there is a need for the project. However, before it can be approved it is necessary to consider the impacts of the proposed development to determine if the impacts of the project are acceptable.

4 TECHNICAL CONSIDERATIONS

4.1 Window of Opportunity

4.1.1 Views of the Applicant

Imperial submitted that new development drilling in Cold Lake needs to be carefully coordinated with the existing steaming operations. As the steam bank moves through the existing operations, wells are steamed, pressured up, and then produced. For safety reasons, new wells can only be drilled in the parts of the field where the reservoir is in the low pressure phase of the cycle. The existing wells around Leming Lake are currently in that low pressure phase. Imperial submitted

that, in order to implement its proposed development at Leming Lake during the current window, drilling needs to commence by mid-1996 to allow steam to enter the south part of Maskwa area in late 1996. Furthermore, if drilling does not occur during the current window, the opportunity would be delayed for at least 2 years until the low pressure phase of the next cycle for the surrounding wells. Imperial estimated that this delay in drilling could result in a reserves loss of up to 100 000 m³ compared to the resource recovery under the current proposal.

Respecting concerns expressed about lake levels, Imperial submitted that it is conducting a study to determine the cause of declining water levels of Leming Lake. It said that the study includes a review of past changes in lake levels and is not focussed on the proposed pads. Imperial stated that the proposed facilities would not contribute to any decreases in the water level of Leming Lake.

4.1.2 Views of the Interveners

STOP did not believe that drilling under Leming Lake should be approved at this time. STOP maintained that ongoing studies on casing failures and their impacts should be completed before proceeding with development under the lake. STOP also believed that horizontal well CSS was experimental and should be tested in another portion of Imperial's lease.

Mr. Duckett submitted that postponing development until the next available window may allow for techniques and technology used to be improved. He submitted that the current ongoing study for Imperial to determine the cause for the declining water levels of Leming Lake is crucial to the consideration of the subject application and that a 2-year delay would allow sufficient time for Imperial to address unresolved issues. He argued that the resource itself would not be lost and that a delay would be appropriate if it could at that time be shown that the necessary studies and the necessary development has been done to warrant this kind of undertaking.

4.1.3 Views of the Board

The Board accepts the constraints on the scheduling of drilling operations within the Cold Lake project and acknowledges Imperial's desire to develop the project within the current drilling window. The Board understands Imperial's argument regarding concurrent operations of adjacent areas, particularly with respect to the advanced stage of depletion of the existing wells around Leming Lake. The pads around the north and east sides of Leming Lake are in their ninth cycle and likely have a limited remaining life under conventional CSS operations. If the project was delayed for 2 years, the lack of pressure support from these adjacent pads would likely have an impact on recovery of the resource due to steam migration to lower pressure areas. The Board also accepts that there could potentially be some positive impact on the recovery efficiency at the existing pads if the proposed development proceeded during the current window, as opposed to waiting for an additional 2 years. The Board therefore accepts that a loss in reserves may result from a delay in drilling until the next available window.

The Board agrees that the study being conducted on water levels at Leming Lake is important to determine if there is any effect of existing operations on the lake and to isolate any adverse effects the current operation may have on the lake level. However, it does not believe there is a need to wait for the completion of the study prior to considering the subject application, because it does not believe that the proposed development would contribute to any measurable change in the water level of Leming Lake.

4.2 Development Options

4.2.1 Views of the Applicant

Imperial said that it considered several options to develop the resources in the Leming Lake area.

The preferred option consists of a combination of conventional directional wells and long reach horizontal wells operated using CSS. The other options considered included:

- ! dewatering the lake to allow for the continuation of the existing regular pad pattern,
- ! using conventional directional wells from near-shore pads plus a single central on-water pad,
- ! horizontal well access from near-shore pads, and
- ! slant well access from near-shore pads.

Imperial rejected the first two of the other options due to high environmental impacts. It also rejected the horizontal well option due to a potentially high recovery risk (up to 800 000 m³ of bitumen). Imperial did not choose the slant well option due to high development and operating costs of applying a different well design. Imperial submitted that the proposed option best meets the design criteria of resource recovery, environmental protection, safe and efficient operations, and reasonable development and operating costs.

Imperial submitted that the proposed development option was not specifically evaluated as part of the biophysical assessment conducted for the application. However, it believed that the impacts of this proposal would lie between the option which included construction of a pad in the centre of the lake plus a number of pads on shore and the option which included only horizontal wells. It submitted that the assessment was comprehensive and complete for the nature and impacts of the proposed development.

4.2.2 Views of the Interveners

STOP opposed the method proposed by Imperial to develop the South Maskwa/Leming Lake area. STOP viewed the use of horizontal wells for CSS operations as unproven and did not believe the application of this technology should be approved under a lake. STOP suggested that Imperial consider another area on its lease to test the use of horizontal wells. On the basis of the recent history of multiple well casing failures at Imperial's projects, STOP believed that further information on causes and mitigative measures is required before development under the lake should be approved. STOP also noted that the proposed development option had not been specifically addressed in the biophysical assessment.

Mr. Duckett objected to any additional development around Leming Lake. In his view, Imperial had already significantly impacted the lake and additional development would further impact the area. The mitigative measures proposed by Imperial did not satisfy his concerns. Mr. Duckett submitted that development of the resource beneath the lake should be delayed until studies currently underway have been completed, and no further development at the project should take place until the public could be assured that it could be carried out in a controlled manner to minimize adverse impacts on the environment.

4.2.3 Views of the Board

The Board agrees that the first two of the other options considered are not desirable due to the environmental impacts that would result. The Board considers the impacts that would result by draining the lake to be severe and unacceptable. The Board also believes that the on-water pad option is not desirable because the potential environmental risks would be significant.

The Board notes that the use of horizontal well CSS has never been tried at Cold Lake and does present a risk of resource recovery. However, the Board understands that the use of horizontal wells does not increase the risk of casing failures or other environmental effects. The Board understands that the steaming strategies at conventional wells at Cold Lake are carefully controlled to optimize recovery through fracture propagation to increase reservoir access. Fracture propagation when injecting into horizontal wells is uncertain and the potential exists for only a portion of the horizontal well to be effectively used. The Board agrees that communication of the horizontal wells with existing steam chambers could negatively impact recovery. The operation of conventional wells around the perimeter of the development would isolate the horizontal wells from the existing development, eliminating the potential for interwell communication. The Board concludes that the proposed well configuration will reduce the risk of resource recovery compared to the use of only horizontal wells.

The Board is satisfied that the proposed development option represents a reasonable balance between resource recovery and environmental protection. However, the risk of casing failures resulting in a surface release in the lake remains and must be assessed before the project can be approved.

4.3 Set-back of Wells from the Lake

4.3.1 Views of the Applicant

Imperial presented the set-back distances to the lake for the closest well on each pad as follows:

Pad/Well	Distance to Historic High Water Mark (m)	Distance to 1994 Water Line (m)
D31-L	85	200
D32-G	70175	
D33-N	75255	
D34-O	60205	
D35-F	160	230

Imperial submitted that the project was designed on the basis that the water level of Leming Lake may return to the historic high water mark at any time.

Imperial maintained that the proposed well locations reflect a balance between maximizing resource recovery and environmental protection by maintaining a reasonable set-back distance from the historical high water mark of Leming Lake. Increasing the well set-back from the shoreline would reduce its ability to use conventional directional drilling techniques and would likely reduce resource recovery due to the uncertainty of performance of horizontal well operations in this application. Imperial said that the proposed directional wells will also provide a buffer between the proposed horizontal wells in the middle of the development and the existing

mature operations which exist around Leming Lake. This will minimize the amount of interference between the new wells and the older mature wells. Imperial estimated that the higher risk from using only horizontal wells would reduce resource recovery by up to 45 per cent. In addition, Imperial maintained that the measures it had implemented to detect and control casing failures, including nitrogen purging and the ability to control failures at higher pressures, along with the mitigative measures that would be implemented, would allow operation of the near-shore pads to be conducted in an environmentally sound manner.

4.3.2 Views of the Interveners

STOP maintained that the existing concept of set-backs from water bodies is not applicable for the subject application. It argued that the set-back requirement does not adequately address horizontal drilling and casing failures of the type Imperial has experienced at its Cold Lake projects, since set-backs refer to a well's surface location. STOP referred to the T Pad incident which resulted in fluids being released to surface over 400 m from the surface location of the wells. STOP believed that a similar occurrence at the proposed project would likely occur in Leming Lake and that such an occurrence could not be contained or remediated. STOP also pointed out that the set-back distances for the subject application were measured from the wellheads and that the pads are much closer to the historic high water mark. According to STOP, if Leming Lake should recover to the historic high water mark, significant environmental impacts could occur. STOP believed that the original intent of set-backs did not consider this type of development and that the set-back requirement should be reviewed by the EUB and Alberta Environmental Protection (AEP).

Mr. Duckett did not believe it was appropriate to have pad development as close to a lake shore as proposed. He expressed concerns that any spills or leakage that could not be cleaned up or repaired immediately would follow the natural drainage into the lake. Mr. Duckett also raised concern for the potential of a release of fluids into the lake, based on the T Pad incident.

4.3.3 Views of the Board

The Board is satisfied that the set-backs proposed by Imperial are acceptable given the mitigative measures to be implemented. While the current lake shore is substantially removed from the pads, the Board recognizes that, over time, the lake level could return to its historic high water mark.

The Board recognizes that current regulations for conventional wells generally require a set-back of 100 m from the high water mark of water bodies. The Board acknowledges that set-backs from water bodies are intended to minimize impacts from potential surface spills and do not provide for the type of spills or releases resulting from underground blowouts similar to the T Pad incident. These types of incidents have shown that surface releases up to 400 m from a well's surface location can occur and in the current proposal could result in a surface release under the lake. The Board considers such a circumstance to be unacceptable from an environmental viewpoint. The Board agrees that a significant loss in reserves would occur by moving the wells back, which would require additional horizontal wells. Accordingly, the Board believes that, if development is to proceed with wells located within the 100 m set-back of Leming Lake, some supplementary protection measure must be in place to minimize or prevent impacts from potential casing failures which could result in a release of fluids to surface.

4.4 Casing Failures - Technical Concerns

4.4.1 Views of the Applicant

Imperial submitted that its investigation of casing failures in recent years identified a number of means to prevent or detect such failures. Imperial said that such failures were primarily due to the high strains and cyclic loads experienced due to thermal stimulation, in the presence of corrosive environments. It said that the proposed operating and detection changes will be applied at the Cold Lake operations in general and will be utilized at the proposed wells. Imperial believed that the preventative and mitigative measures in place would allow the South Maskwa/Leming Lake development to be operated in a safe, environmentally responsible manner.

Imperial stated that experience has shown that the wellbore conditions are important variables to consider in the prevention of casing breaks. Imperial said that temperature and gas composition relative to levels of hydrogen sulphide and carbon dioxide during certain portions of the cycle are important factors contributing to the initiation and propagation of SSC. To mitigate the risk of SSC, Imperial has instituted the practice of purging the annulus of soaking or shut-in wells with nitrogen. Imperial submitted that this practice would be instituted from the start of operations at the South Maskwa/Leming Lake wells and, as a result, believed that the likelihood of a casing break will be significantly reduced.

With respect to casing integrity monitoring, Imperial submitted that the Leming Lake wells will be equipped with computerized equipment that will detect casing breaks during steaming operations. A monitoring program developed in the mid-1980s, and subsequently improved, utilizes flowrate and pressure measurements to detect casing breaks during the steaming phase of the operation. Imperial submitted that, in the event a casing break does occur, it has the ability to detect the break quickly during high pressure portions of the cycle so any consequences are kept to a minimum. The nitrogen purge procedure also allows for casing pressure to be monitored during the soak period to detect any breaks.

Imperial submitted that, during 1995, it significantly enhanced its ability to control a well in the event of a casing break. Techniques were developed and tested that allow the wells to be controlled at all pressures up to approximately 10.5 MPa. In the past, it was unable to control wells until pressures had declined to less than approximately 7 MPa. Imperial believed that this new technique now gives it the ability to quickly move on to wells in virtually any situation. Imperial stated that, in the unlikely event that an intermediate casing break occurs, it has the ability to detect and control these failures. Imperial also stated that operations personnel have been trained in emergency response and spill control and have practiced utilizing containment and response equipment necessary to contain a casing failure incident. The applicant also confirmed that it is standard operating practice at Maskwa to visit each pad four times daily, twice during the daytime hours and twice during the night.

Imperial contended that normal CSS operations do not cause instability of the shales of the Colorado group of a magnitude that could cause primary casing failures. It submitted that measurements of vertical compaction and expansion, as well as lateral movements, within the shales support its conclusion that movements during normal operations do not give rise to primary casing breaks. Imperial indicated that significant volumes of fluid have to be introduced

into the shales to cause destabilization. It maintained that steam injected into the Clearwater Formation does not reach the shales, and that it is confined by the casing cement as well as the overlying Grand Rapids Formation. Imperial further submitted that the casing is designed to accommodate normal movements within the shales.

4.4.2 Views of the Interveners

STOP believed that the cause of casing failures was not adequately understood and that the role of the destabilization of the shales of the Colorado group required further research. STOP expressed concern respecting the operating temperatures and pressures used by Imperial in its recovery process and noted that other companies in the Cold Lake area operating at lesser temperatures and pressures did not experience the same rate of failures as Imperial's projects. A concern was also raised regarding the number of failures which have occurred at the existing pads around Leming Lake which have the same type of casing installed as Imperial proposes to use at the proposed project. STOP maintained that it would take up to 2 years of failure-free operations to confirm that the mitigative measures Imperial has implemented are effective. STOP also believed that it was too soon to determine if the effect of casing failures at AA Pad and T Pad at Imperial's Leming project could be fully remediated or reclaimed and that the impacts should be determined before approving the proposed development.

4.4.3 Views of the Board

The Board believes Imperial's investigation of recent casing failures has advanced the knowledge of such failures. The Board considers casing failures at the Cold Lake project to be a significant concern. It believes that the mitigative measures Imperial has implemented will reduce the potential for a casing failure to result in fluids being released to the surface, but believes that additional operating experience with these measures in place is required to prove their effectiveness. The Board also expects Imperial to continue its work on investigating the causes of casing failures and to implement improvements as they are identified to prevent such failures.

4.5 Casing Failure Risk Assessment

4.5.1 Views of the Applicant

Imperial confirmed that the risk estimates of a surface release resulting from a casing failure at the proposed development contained in the application and in the biophysical assessment are based on past experience. It submitted that the potential risk of a surface release would be significantly reduced by the improvements that had been made in the area of casing design, well operations, monitoring practices, and well control capabilities but did not quantitatively estimate the risk reduction. Imperial evaluated the surface releases resulting from casing failures that occurred in the past, particularly due to earlier practices, and performed an assessment based on the practices used today. It believed that the releases would have been prevented from happening using current operating practices. Imperial acknowledged it could not guarantee there would not be a casing failure in the proposed application, but asserted that the measures implemented would prevent a T Pad type incident from occurring.

Imperial submitted that the risk of a casing failure occurring at a horizontal well would be the same as a conventional directional well. However, it stated that the number of wells would be reduced through the use of horizontal wells, effectively reducing the overall project risk of a casing failure.

4.5.2 Views of the Interveners

STOP submitted that the risk assessment presented in the application was irrelevant today as it was performed before the T Pad incident. It argued that the risk factor would be higher today since an additional 27 casing failures had occurred or been detected since the T Pad incident. STOP also believed that additional operating experience with the mitigative measures in place would be required before determining the effectiveness of reducing the failure rate.

On the basis of Imperial's evidence, Mr. Duckett suggested that there could be ongoing progress in the development of new techniques and new materials that would eliminate the chance of a T Pad type incident. He submitted that the risk could be reduced 2 years from now when the next window of opportunity is available. He also believed that Imperial would be in a better position at that time to prevent or react to any kind of spill.

4.5.3 Views of the Board

The Board believes that Imperial's risk assessment presented at the hearing is based on past experience prior to the T Pad incident and is not representative of the current situation. The Board also believes that mitigative measures Imperial has implemented to detect and control casing failures should reduce the chance of an incident similar to the T Pad blowout. However, given the lack of experience of the new monitoring and control measures in other areas of the project, the Board finds it difficult to determine with any degree of confidence that a multiple well casing failure is unlikely to occur in the future. Considering the circumstances, the Board believes it imprudent to presume no such failures would occur during the life of the wells. In the Board's view, such a failure in a water body would have more serious consequences than those experienced to date. While all failures caused by destabilization of the shales are a concern, the Board believes supplementary measures to prevent casing failures in the area would largely remove that concern.

4.6 Casing Design

4.6.1 Views of the Applicant

Imperial proposed the current CLPP casing design of L-80 grade pipe with oversize buttress connections (OBT&C) for the Leming Lake development. Imperial stated that recent evaluations have confirmed that L-80 grade casing offers the most SSC resistance of several pipe grades tested. Imperial also believed that the OBT&C connections have proved to be the best connection design to date at the Cold Lake operations, providing the best combination of high strength, sealability, and low hoop stress. While it has confidence in the OBT&C connection, Imperial said it is continuing to evaluate other connections to improve sealability and to reduce potential leakage to other formations.

Imperial believed that the formation movements under current operations are within the design capabilities of the casing. It based its conclusion on the analysis of measurements of vertical compaction and expansion, as well as lateral movements, from extensometer and inclinometer wells. Imperial reported that normal CSS operations would not cause instability of the shales of the Colorado group of a magnitude which would cause a primary casing failure.

Imperial did not believe that surface casing set to the base of the shales of the Colorado group would provide additional environmental protection over the current well design involving no surface casing. It submitted that the additional casing string would not protect the production string from the internal wellbore environment and could delay but not prevent the occurrence of some intermediate casing failures. If the annulus between the surface and production casing were cemented, failure detection would be difficult and the cement would not be an effective barrier to prevent released fluids from reaching the surface casing where corrosion and cracking could take place.

Imperial also conducted a preliminary analysis on a casing design which would leave the annulus between the surface and production casing open. Imperial believed that this alternative offered some advantages over the existing design, but had some concerns regarding its installation and operation. Imperial questioned the ability to achieve an adequate cement job in the interval immediately above the casing shoe, in terms of placement and quality. Imperial was also unaware of a commercially available packer or sealing element which would provide an effective seal between the casing strings at the temperature range encountered in the wells. Imperial believed that a seal was required to eliminate the potential for a corrosive environment in the annulus. Without the seal, access to the wellhead would be restricted and the ability to detect a failure would be reduced.

Imperial submitted that any new casing design would have to be further evaluated and would require field testing over a couple of steam cycles. It estimated that it could take up to 2 to 5 years to determine the suitability for commercial application.

4.6.2 Views of the Interveners

STOP noted the concerns expressed at the time of the Imperial megaproject hearing regarding casing design, casing failures, and the setting of surface casing. STOP believed that the use of surface casing on all wells may have prevented some of the impacts of the casing failures Imperial has experienced and suggested that if the money was spent on prevention, Imperial may not have had to spend the money now on the investigation and remediation.

4.6.3 Views of the Board

The Board acknowledges Imperial's extensive investigation, testing, and development of improved thermal casing design over the years at its Cold Lake projects. The Board is also supportive of continuing research and development by industry to improve thermal casing and connection design. The Board notes that the use of L-80 grade casing with OBT&C connections has been accepted as an industry standard for thermal use for some time. Although the Board accepts that the mitigation measures implemented by Imperial should be effective in reducing casing failures and impacts, it believes that additional operating experience is required to prove that effectiveness. The Board considers potential failures near water bodies to be particularly significant given the added environmental impact. It is the Board's view, in the event a casing failure occurs that cannot be controlled and erupts to surface in the lake, the entire area and its surroundings would be contaminated. The Board does not accept that the detection methods proposed would allow Imperial sufficient time to control the size and location of the surface release. It is also highly unlikely that Imperial could isolate the contamination. In the Board's view, all reasonable efforts should be made to avoid such an occurrence. In summary, the Board considers a release beneath the lake as unacceptable. It is not convinced that the lake could be fully remediated in a reasonable time frame if a failure similar to the T Pad incident occurred. Continued operations of the commercial project under those circumstances would be at some additional risk.

The Board believes that the installation of surface or intermediate casing to cover the shales of the Colorado group would provide assurance that the lake and near-shore area would not be impacted by the operation of near-shore facilities. The Board understands that filling the annulus between the surface/intermediate and production casing with cement would not allow for the detection of a failure of the primary casing string and that the break would go undetected until the failure of the surface casing occurred or until fluid reached the surface. The Board also understands that a casing design which would leave the annulus between the two strings open would likely require further engineering and testing. The Board believes, however, that the Leming Lake development within the Cold Lake project is unique in many respects. Implementation of a proper casing design offers additional protection for the lake and its surrounding environment, as well as operating experience with such designs for further applications.

The Board will condition the approval to install surface or intermediate casing if the development is found to be in the general public interest.

5 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

5.1 Views of Imperial

Imperial submitted that the proposed project could proceed in a safe and environmentally responsible manner given the preventative and mitigative measures it was prepared to implement.

Imperial committed to implementing some 35 mitigative measures recommended in the biophysical study conducted for its development proposal. Imperial maintained that these measures, combined with the proposed operational practices, would allow it to mitigate potential impacts, as well as respond quickly to any incident which may occur. Among the mitigative measures Imperial committed to include:

- ! a minimum set-back distance, for the closest well, of 60 m from the historic high water mark of Leming Lake,
- ! minimizing surface disturbance to reduce habitat loss,
- ! effluent containment through berm construction, and
- ! development of a site specific spill response plan which includes conducting spill response exercises.

Imperial also proposed to implement a number of environmental monitoring programs to assure early detection and prevention of adverse impacts. These programs would include, but are not limited to:

- ! monitoring and collection systems for fluid seepage from the pads,
- ! collection and analysis of water samples from Leming Lake twice per year, and
- ! monitoring of ground water levels in the deeper aquifer to the north of Leming Lake.

Imperial acknowledged that there would be some impact to trapping in the vicinity of the project, but believed that it would be minimal. It noted that the proposed activity is within areas of other activity and that the primary effect on the trapper has already occurred. Notwithstanding that position, Imperial attempted to reach a settlement with Mr. Duckett. Imperial maintained that, if an agreement cannot be reached, the matter should be referred to the Trappers Compensation Board.

Imperial also summarized the socio-economic effect of the project. Imperial submitted that it has more than 250 employees and over 200 contractors at the operation at Cold Lake. The drilling of new wells and construction of new facilities would employ additional contractors. Directly, an estimated 120 person-years of work would be involved in the construction and operation of the Leming Lake development. Imperial estimated that the proposed project would cost about \$40 million, of which more than \$10 million would be spent in the local area. Indirectly, the project would also result in multiplier effects from capital expenditures, incremental taxes in the area, and increased royalties to the government.

5.2 Views of the Interveners

STOP considered the application to be deficient in a number of areas and did not believe it should be approved at this time. It submitted that the processes used to consider applications such as the Leming Lake proposal should be more integrated and have the participation of all interested and concerned parties. As well as addressing environmental concerns, the applicant must also have regard for impacts of a social nature affecting such persons as native people, trappers, fisherman, farmers, and local residents. By example, STOP raised the concern that it did not seem that Imperial had a water management plan in place, particularly for the long term.

STOP also argued that Imperial's biophysical report was inadequate since it did not address the cumulative effects of its project. Further, STOP raised the concern that the presence of carcinogenic and mutagenic compounds may be present in the surface sediments as a result of Imperial's operations. Given this, STOP believed that a full and comprehensive study of the ecological risk associated with the release of chemicals, such as polycyclic aromatic hydrocarbons, and heavy metals be done for this area before it can be considered for development.

STOP cautioned that significant impacts could result from such incidents as uncontrolled release of fluids both at surface and in the sub-surface.

STOP believed that the matter of public interest in the consideration of industrial applications had been reduced to an economic issue. It did not believe that the benefits of economic development and royalty revenues balanced the environmental and health impacts that could result from the oil sands development in the Cold Lake area.

Mr. Duckett submitted that, in general, the influx of industry into the region had a significant impact on his trapping activities and had affected quantities and quality of fur, as well as the style and nature of trapping. These impacts could include interference to travel patterns, breeding habits, and reproduction of furbearers. As well as directly affecting furbearers, such development also impacts the region through increased access. As access increases, more vehicle travel in a region is allowed and more recreational activity and increasing disturbance to an area occurs. While improved access to his trapline may be of limited advantage to the trapper, Mr. Duckett did not believe there was any substantial benefit to the lifestyle of a trapper from industrial development. In Mr. Duckett's view, the environmental impacts of the project could be more costly to the public than the benefits it would provide.

Mr. Duckett also raised concerns about the specific impacts this project could have on the Leming Lake area. He noted that the water level of Leming Lake has been dropping and noise pollution from development activity could impact furbearers. He also believed that contamination of water would impact Leming Lake and associated animals on the food chain. Mr. Duckett stated that he did not believe that Imperial could implement sufficient mitigative measures to adequately satisfy his concerns.

Accordingly, Mr. Duckett believed that the Board should not approve the amendment of the scheme at this time. He suggested that a complete environmental impact assessment (EIA) be conducted addressing social, environmental, and economic issues.

5.3 Views of the Board

The Board cannot accept the position of STOP that the application is either deficient or the review process is flawed such that it would prevent the Board from making a decision on the application.

The Board notes the current application is to amend the existing project Approval No. 3950. As such, the matters before the Board are only the impact and the method by which the applicant will recover the reserves in proximity of Leming Lake. The Board is satisfied that Imperial's commercial scheme is operating within the terms of its original approval and is meeting the environmental standards imposed on the project. Imperial is subject to strict emission levels and release of fluids. Given that the project is subject to regular monitoring by the Board and AEP and the Board is satisfied that any anomalies would be detected. In general, the Board sees no need to review the terms and conditions of the commercial project at this time. The Board also accepts that Imperial is operating within the water management plan imposed by AEP.

The Board acknowledges the concern raised by Mr. Duckett that increased industrial activity will impact trapping activity in the area. Respecting the current proposal, the Board notes development would be entirely within an area that has been affected by the commercial project. The Board notes that the current trapping activity in the project area is minimal. Given the circumstances, the Board believes it is unlikely that approval of the proposed development would have a further material negative effect on Mr. Duckett's current trapping activity. Notwithstanding the questions raised by Mr. Duckett about the ability and inclination of the Trappers Compensation Board to deal with his claim, the Board believes that the Trappers Compensation Board is able and prepared to deal with the compensation issues associated with his trapline in the Cold Lake area.

The Board believes adequate notice of the proposed changes and of the hearing has been given to the public and impacted parties have been provided ample opportunity to raise any concerns with the Board.

The Board notes that the initial application submitted by Imperial for scheme approval was subject to an EIA. The Board also notes that AEP issued environmental approvals for the proposed development and did not designate the project as requiring an EIA. The Board is satisfied that sufficient environmental assessment and information has been provided for the Board to assess the impacts of the specific application before it.

The Board finds the mitigative measures proposed by Imperial to be appropriate and believes these should reduce the risk of an incident to an acceptable level. The Board accepts the continuous monitoring programs required of the project will assure long term compliance with the standards.

Should any incident occur, the Board will assess the implication and expects immediate action by Imperial to remediate any impacts. Imperial has the full responsibility and liability to address such impacts.

In summary, the Board does not accept that the current proposal should be delayed for the reasons identified by STOP or Mr. Duckett.

6 DECISION

Having carefully considered all the evidence presented, the Board concludes that the requested amendment for the commercial scheme is in the public interest. Given the existing regulations and the proposed mitigative measures and continuous monitoring proposed by Imperial, and the additional measures to reduce the risk of casing failures required by the Board, the Board believes the project can proceed in an environmentally and socially acceptable manner.

Subject to the following conditions and the approval of the Lieutenant Governor in Council, the Board is prepared to approve the project:

- (1) All wells associated with this project must have surface or intermediate casing installed to cover the shales of the Colorado group and the final casing design shall allow for monitoring of the annulus between the casing strings for detection of possible casing failures in the primary production string.
- (2) The final casing design is subject to approval of the Board.

DATED at Calgary, Alberta on 10 May 1996.

[Original signed by]

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

[Original signed by]

N. W. MacDonald, P.Eng.
Member

[Original signed by]

J. D. Dilay, P.Eng.
Member

ALBERTA ENERGY AND UTILITIES BOARD

Calgary Alberta

APPLICATION TO AMEND APPROVAL NO. 3950

IMPERIAL OIL RESOURCES LIMITED

COLD LAKE PRODUCTION PROJECT

SOUTH MASKWA/LEMING LAKE DEVELOPMENT

Decision D 96-3

Application No. 950185

Approval No. 3950 was issued to Imperial Oil Resources Limited (Imperial) in September 1983 for commercial development of the Clearwater oil sands deposit using cyclic steam stimulation. On 31 January 1995, Imperial applied to the Alberta Energy and Utilities Board (the Board), pursuant to Section 14 of the Oil Sands Conservation Act for an amendment to Approval No. 3950 to allow the use of a combination of directional and horizontal wells to access oil sands reserves beneath Leming Lake.

Interventions and submissions in opposition and support of the amendment were filed with the Board from various interested parties affected by the proposed development.

The application was considered at a public hearing in Grand Centre, Alberta, on 13 and 14 February 1996 before Board Members F. J. Mink, P.Eng, N. W. Macdonald, P.Eng., and J. D. Dilay, P.Eng.

Having carefully considered all of the evidence, the Board believes the project is in the public interest and is prepared to approve the application. Considering the unique circumstance of this development however, the Board believes some additional measures are required to reduce the risk of casing failures.

Accordingly, the Board will direct that:

- (1) All wells associated with this project will be installed with surface casing to the base of the Fish Scale zone and the final casing design should allow for monitoring and detection of possible casing failures in the primary production string.
- (2) The final casing design is subject to review by Board staff and approval of the Board.

A detailed report providing the reasons for the Board's decision will be released shortly.

DATED at Calgary, Alberta, on 11 April 1996.

ALBERTA ENERGY AND UTILITIES BOARD

[Original signed by]

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

[Original signed by]

N. W. MacDonald, P.Eng.
Board Member

[Original signed by]

J. D. Dilay, P.Eng.
Board Member