

**Decision 99 – 16
Canadian 88 Energy Corp.
Application to Drill a Level 4
Critical Sour Gas Well in the
Lochend Field**

Decision Summary

(This summary repeats the “Views of the Board” taken from EUB Decision 99-16 which is 42 pages in length. It does not include “Views of Cdn 88,” or “Views of the Interveners.” Those views are available in the full Decision report, which is available on the EUB website at www.eub.gov.ab.ca)

APPLICATION AND HEARING

Canadian 88 Energy Corp. (Cdn 88) applied, pursuant to section 2.020 of the Oil and Gas Conservation Regulations, for a licence to drill a level 4 critical sour gas well to be located at Legal Subdivision 10 of Section 35, Township 26, Range 3, West of the 5th Meridian (10-35 well). This location is approximately 11 kilometres north west of the City of Calgary.

The application and interventions were considered at a hearing in Calgary, Alberta commencing on 4 May 1998, before Board Members F. J. Mink, P.Eng., J. D. Dilay, P.Eng., and G. J. Miller.

ISSUES

The Board considers the issues respecting the application to be:

- need for the well
- proposed location of the well
- potential H₂S release rate
- drilling and completion considerations
- public safety risks
- emergency preparedness
- land use impacts and
- public consultation

NEED FOR THE WELL

The Board notes that, while a number of parties argued against the development because of its public health and safety aspects, there was little dispute about the need for the well and Cdn 88's right to recover the natural gas underlying Section 35-26-3 W5M. The Board acknowledges that the ability to exercise property rights are a compelling component of determining need for the well unless other public interest issues related to the development are of overriding interest. The Board accepts Cdn 88's right to explore for its gas resources in the Lochend area and accepts that, provided the development can be carried out in an acceptable fashion, there is a need for the well.

PROPOSED LOCATION OF THE WELL

The Board notes that Cdn 88 identified the proposed location seismically and that it identified it as its optimum location providing the greatest chance for success of its exploratory well, matters not disputed by the other parties. The Board also notes that the surface owners were satisfied with the location of the proposed well. While other interveners considered other surface locations to be more appropriate, the Board is satisfied the proposed location meets or exceeds the normal requirements for siting of such wells. The concerns about siting of the well raised by the interveners related largely to impacts and risk of personal safety which are discussed in some detail in the decision.

POTENTIAL H₂S RELEASE RATE

The Board recognizes that determining the H₂S release rate is an important element in preparing for and drilling critical sour wells in a safe manner. Implied in the process is identifying parameters that could realistically be encountered in the operation. The Board's expectations are clearly stated in ID 97-6 and are repeated below:

- the maximum concentration that can be expected and the source of that information
- the maximum surface deliverability that can be expected against zero back pressure for casing or open-hole flow configuration
- the methodology used to determine the above

The Board accepts the Caroline Beaverhill Lake A Pool as a reasonable analog to be used for the proposed Lochend well. The Board notes that H₂S concentrations as high as 59 per cent are on record for the analog pool. However, many of these concentrations, specifically those greater than 34 per cent, were obtained from samples of separated well streams and are not representative of the reservoir fluid. The H₂S concentration in the wellbore fluid of 33.9 per cent used by Cdn 88 is acceptable to the Board.

The use of wellhead deliverability, instead of sandface deliverability, is more realistic and is an acceptable approach as dictated by ID 97-6. The Board notes that Cdn 88 did not use the maximum surface deliverability of the three similar wells, but rather used the wellhead rate based on the one sandface rate available in the EUB records for the three similar wells. Given that the maximum surface deliverability of the three similar wells of 2450 10³m³/d is only about 8 per cent greater than the flow of 2266 10³m³/d used by Cdn 88, the Board considers Cdn 88's estimate to be a reasonable representation of the maximum surface deliverability. The Board cannot accept that exaggerated levels of H₂S that cannot be reasonably substantiated in the fluid should be incorporated into the evaluation. In summary, the Board accepts the methodology presented by Cdn 88 in evaluating the potential H₂S release rate.

DRILLING AND COMPLETION CONSIDERATIONS

The Board believes that the practices and procedures used during the drilling of any well, in particular a critical sour well, are integral to ensuring public and environmental safety. In this respect, it is generally satisfied that its requirements as detailed in ID 97-6 are adequate. The Board notes the importance of the ARPs for Drilling Critical Sour Wells to provide sound guidance to licensees. The current requirements and recommended

practices were developed in response to the 1982 Lodgepole blowout with great care and effort, and reflect the importance placed on safe drilling operations and contingency planning to prevent or respond to inadvertent events. The Board believes that the requirements and recommended practices expected from industry since then have contributed significantly to safe sour gas drilling and operation within the industry.

The Board notes that Cdn 88 is an active explorer of sour gas reserves in Alberta, and it is aware that Cdn 88 has drilled numerous sour gas wells. While it notes Cdn 88's statements of intent to meet or exceed EUB requirements and implement industry recommended practices, it recognizes that concerns were expressed about Cdn 88's ability to effectively undertake the drilling plan for the proposed 10-35 well. The Board is alarmed at the lack of trust in the company to fulfill its obligations under the regulations.

Regarding the need for a diverter system to be installed during the drilling of the surface hole, the Board notes that the purpose of a diverter system is to redirect fluids from the well in the event of a fluid influx into the wellbore. The Board accepts Cdn 88's conclusion that a diverter is not required, and it is satisfied that 440 m of surface casing is sufficient for the drilling of the intermediate main hole.

The Board notes that, while a minor occurrence of lost circulation at depths where Cdn 88 would be drilling the intermediate main hole was reported from the nearby offset 8-13-27-03W5M well, the well was successfully drilled, cased, and cemented. Accordingly, the Board is satisfied that the provision for materials as identified by Cdn 88 to address potential lost circulation is adequate for the 10-35 well.

With respect to completion and testing of the 10-35 well, the Board would, as Cdn 88 noted, require a new application before any well testing could proceed. While it agrees with the Committee's suggestion that sour well testing should be done into a pipeline where possible, it believes that testing could proceed if done in accordance with EUB guidelines. Respecting suspension of the well, the Board is satisfied that the measures Cdn 88 plans to take to suspend the 10-35 well safely represent acceptable industry practice. The Board recognizes

Mr. Goodhart's concerns respecting vandalism of oil and gas facilities, however, it believes the risk to be very low. Notwithstanding, the Board recognizes the important role of appropriate emergency response plans should a release of sour gas occur for any reason.

The Board notes the specific concerns raised by the Coalition about Cdn 88's casing bowl welding procedure, as well as the more general concerns related to Cdn 88's management processes for equipment design, specification, procurement, construction, and operations. Respecting the issues related to the casing bowl, the Board notes that it would play a reduced role in well containment after intermediate casing has been run, and that there was no evidence presented indicating overall industry problems related to surface casing bowl weld failures. However, it believes that appropriate welding procedures must be employed to maintain the highest wellbore integrity possible. Respecting the management processes used by Cdn 88 for equipment design, specification, procurement,

construction and operations, the Board accepts that Cdn 88 has completed numerous sour gas wells in the recent past. However, it is not satisfied with Cdn 88's general response that these matters were simply the responsibility of its drilling manager. It believes that these processes are integral to successful implementation of the regulatory requirements and that Cdn 88 should more clearly demonstrate and communicate industry practices to the public. In view of this general concern respecting materials selection, and given its importance to overall wellbore integrity, both during drilling operations and any subsequent production operations, the Board believes it would be prudent to review the steel mill certificates specific to the casing and drill pipe to be used. Additionally, while it notes Cdn 88 plans to qualify existing drill pipe in accordance with ARP 1.2.3, it believes that drill pipe meeting the requirements of ARP 1.2.5 New Grade E Specifications and/or ARP 1.2.6 SS-95 Drill Pipe Specifications would further reduce operational risk, and therefore, would specify it for the drilling of the 10-35 well, if approved.

In general, respecting drilling, completion and production matters, the Board is satisfied that the equipment and procedures proposed by Cdn 88 to drill the 10-35 well are consistent with regulatory standards including the APR for Drilling Critical Sour Wells. However, in recognition of the sensitivity of the location as demonstrated by the concern of the nearby residents about Cdn 88's abilities to undertake safe drilling operations, the Board would require the following to grant a licence for the 10-35 well:

1. Develop and document the management processes, including policies and procedures for equipment design, specification, procurement, construction and operations, including an assessment of the effectiveness of them by a suitably qualified third party.
2. Confirm the aforementioned management processes are applied and demonstrate clearly that the equipment and procedures to be used by the contractors selected are suitable for the intended service. Additionally, Cdn 88 would be required to demonstrate to the EUB that all personnel employed in the drilling operation are experienced in sour gas drilling operations and hold the necessary certifications.
3. Develop and document a casing bowl welding procedure by a qualified professional engineer to be included in its detailed drilling plan.
4. Submission of a report respecting the review of steel mill heat certificates for the casing and drill pipe to be used in the construction of the 10-35 well.
5. Drill pipe meeting the requirements of ARP 1.2.5 New Grade E Specifications and/or ARP 1.2.6 SS-95 Drill Pipe Specifications or better be used for the drilling of the 10-35 well.
6. Daily communication with the EUB Calgary South Field Centre, including submission of daily drilling reports during the critical period.

7. Attendance by EUB Field Surveillance personnel at pre-spud and pre-critical zones penetration safety meetings.

In addition to Cdn 88 having to meet the above conditions, the EUB would carry out detailed EUB drilling rig inspections prior to spud, and drill out of intermediate casing, including blowout prevention drills.

PUBLIC SAFETY RISK ASSESSMENT

Issues considered in reviewing the public safety risk assessment are:

1. purpose and approach
2. source characterization
3. uncontrolled sour gas releases
4. consequence modeling
5. risk evaluation

Purpose and Approach

The Board believes that before risk can be managed, it must be understood. Prior to making decisions and taking action, the risk management process develops options and evaluates their impact with respect to public safety. Risk assessments have several purposes:

1. To understand the nature and the extent of the risk and the factors that predominate the risk
2. To establish the extent of reasonable emergency awareness planning zones taking into consideration plume dispersion modelling for H₂S and SO₂
3. To compare the risks of this proposed development to other familiar risks
4. To address concerns of the public in the area which may be impacted by accidental releases
5. Cdn 88 has focussed on item 3, comparing the risk of the well to show that the risks are acceptable, and in the Board's view did not address the other issues adequately

The Board believes that quantitative analysis should be one of a number of factors used to evaluate the risk of facilities. Considering the wide variety of factors that need to be considered, the Board also believes reasoned judgement to be a critical component of any evaluation or decision to proceed with such projects. The EUB has no prescribed method of performing risk assessments, although it has published many documents and has been involved with several public consultation committees in order to provide some guidance on the matter. There are also many other references outlining approaches to doing risk assessments. Quantitative risk analysis requires considerable computer modeling to simulate the release events. The assumptions and approach used in such models should be conservative but realistic. The uncertainties associated with the risk estimates should be discussed.

Source Characterization

An important step in analyzing the risks is defining the source conditions. Clearly, from the evidence presented, a lighter-than-air sour gas composition is not expected. Accordingly, none of the lighter-than-air sour gas mixture results submitted were considered by the Board.

Defining the release conditions at atmospheric pressure, before air is entrained is critical in estimating the dispersion and rise of the release determined by the model. This is evidenced by the long narrow plumes predicted by Cdn 88 versus the short wide plumes of the interveners using very different inputs to the SLAB model for the same release. The Board expects some liquids to be present as an aerosol at the reduced temperatures associated with expansion to atmospheric pressure. A dense gas model is therefore required. The Board believes that a reasonable conclusion would be somewhere between the diverse range of predictions by the experts of Cdn 88 and interveners.

Frequency of Uncontrolled Sour Gas Releases

The Board concludes that there is no significant difference between the uncorrected blowout probabilities used by Cdn 88 and interveners. The Board believes that the annualization factors used by Cdn 88 are not applicable to drilling release probabilities or servicing release frequencies. For drilling, the release probability is an event-based statistic, and since there is one drilling event per year, the annualization factor is one. Therefore, the risk estimates presented by Cdn 88 for drilling are low by a factor of 13. For servicing, the release frequency is based on the assumption that one servicing operation is made per well per year. The servicing rate is already on an annual basis, and therefore, should not be reduced by the annualization factor of 26 used by Cdn 88.

An application of the critical well factor to reduce the blowout probability is acceptable to the Board. Although no statistical evidence exists, in the Board's judgement the 0.25 critical well factor and the application of a depth correction factor is reasonable for this situation. The Board believes that the exploratory well factor is inter-related to the depth correction factor. Cdn 88 did not mention either of these factors in its risk analysis. Given the previous EUB-published work on well blowout probabilities, the Board expected discussions on why deeper exploratory wells tend to have higher blowout rates and what is being done by Cdn 88 to prevent similar cases from happening.

The Board notes that the term "immediate ignition" has been used loosely by industry and could lead to some confusion about ignition in the mind of the public. The probability of ignition cannot be accounted for until attempts have been made to ignite the release. Obviously a one minute sour gas release would have considerably less consequences than a 30-minute release. The Board believes that the risk results presented by the interveners showing the importance of reduced ignition delay time are significant. Cdn 88 committed to demonstrating that an ignition delay time of one minute to quickly evacuate the drilling

crew to safety is achievable. A similar commitment will be required for servicing operations should the well be approved.

Consequence Modelling

Given the work that has been done in Alberta to date, the Board believes a probit approach with triple-shifted Rijnmond parameters is helpful in evaluating the risk from sour facilities. The Board notes the Advisory Committee specifically recommended that irreversible health effects, defined by the triple-shifted Rijnmond parameters be identified as a criteria for defining consequences from sour gas exposure. The Board believes these conservative results can then be used to estimate risk for comparison to risk acceptability guidelines. Mitigative steps can also be adopted to reduce the identified risk and to avoid unnecessary risk on the hypersusceptible population.

The Board notes that the lethal threshold of 500 ppm for H₂S presents different results to those using the triple-shifted Rijnmond parameters. The Board also notes that Cdn 88 had redone the SLAB risk assessments using a triple-shifted probit parameter approach and concluded

Cdn 88's H₂S modeling using SLAB is of limited use to the Board because the source term is inappropriate. Given the high H₂S, carbon dioxide and heavy hydrocarbon composition of the sour gas, a fraction of the sour gas release is expected to be in the form of an aerosol once it has expanded to atmospheric pressure and before air is entrained. The SLAB model simulates the initial dense behavior as air is added and the liquids evaporate resulting in a sour gas-air mixture. The Board considers the results presented by the interveners to be more representative of a potential release than those of Cdn 88.

The concentration contours of maximum predicted ground-level SO₂ provided by Cdn 88 have purpose in verifying the size of the EPZ but they are not useful during an emergency. The Board suggests that plume isopleths for the range of dispersion conditions would be helpful to emergency measures organization. The Board expects Cdn 88 will work with all affected emergency measures organizations to assist in the preparation of such plans.

Risk Evaluation

Public safety is of paramount concern to the Board and therefore the risks of sour gas developments are taken very seriously. Cdn 88's submissions suggest that the risks associated with level 4 wells are negligible relative to other risks typically encountered in society. Recognizing adjustments discussed earlier for source term, frequencies and probit parameters, the Board believes Cdn 88 has underestimated the risks. The Board also believes the use of over conservative parameters in risk assessments would present an unrealistically high level of risk from such facilities. The Board suggests that realistic factors which have a foundation in fact or judgement should be the norm to evaluate risk. Where the risk is found to be acceptable, but mitigative steps can be taken to reduce or

minimize that risk, such steps should be taken. Using the risk estimates supplied by the interveners as an upper estimate, the Board believes by strict adherence to the risk control measures, required in the existing regulations and the extra conditions included in this decision, the actual risk to the public to be very small.

In the Board's view, the proposed well does not represent a materially higher risk than existing facilities throughout Alberta. However, with respect to acceptable levels of risk, the Board disagrees with Cdn 88's conclusion that the Advisory Committee suggested an absolute risk of 10^{-4} to be acceptable. Risks of 10^{-4} were predicted within level 4 pipeline right of ways in the Advisory Committee studies. As no one lives within 100 m of level 4 sour gas pipelines, the public is not exposed to these maximum levels. The Board notes however that the Advisory Committee concluded after extensive study and consultation that the present setbacks from all sour facilities are acceptable. The Board also notes that the risk at a setback of 100 m from a level 4 pipeline is about 10^{-5} (10 in a million) in the Advisory Committee studies and that this is comparable to what other jurisdictions consider acceptable for low population densities. The Board does not believe it appropriate to adopt specific limits for acceptable levels of individual risk but rather considers each application on its own merits.

The Board does not agree with justifying the size of an emergency response planning zone on the basis of predicted risk. Emergency response planning is done to facilitate appropriate actions being taken for a reasonable worst-case release scenario to ensure the safety of the public. The priority in such remote events must be on the public in close proximity to the facility where the risks are the greatest. Sound contingency plans should be in place to advise those within the awareness zone who could be affected but are in little immediate danger. Companies cannot be expected to plan for the absolute worst case imaginable event, but they must plan for events that have a reasonable chance of occurring. Mitigating factors such as igniting the release can be accounted for recognizing that there could be a modest delay in ignition.

EMERGENCY PREPAREDNESS

The Board is satisfied that Cdn 88 has developed a comprehensive ERP that meets EUB general requirements, although some enhancements are necessary due to site specific circumstances as discussed in this section. The Board requires operators to develop site specific ERPs for the drilling of sour gas wells. Each plan must identify the size of the EPZ being used and must address site specific measures to be taken to protect the public in the event of an emergency. Although the operator's plan is expected to focus on actions to protect the public within the EPZ, it must also address how the plan will be coordinated with municipal and provincial plans for assistance and protection of the public beyond the EPZ. Board policy provides applicants with the opportunity to apply to use a reduced EPZ, where the calculated EPZ would be considered unmanageable in the early stages of an emergency. The criteria used to determine whether a reduced EPZ is appropriate includes a review of the size of the calculated EPZ, local terrain, population density, evacuation, ignition and sheltering criteria, and air quality monitoring strategy. Several components of the ERP would usually require enhancement if a reduced EPZ is approved.

The Board notes that Cdn 88 has proposed to use a 4-km EPZ with an additional awareness zone to 8-km. The purpose of the awareness zone would be for notification only to residents of drilling and testing operations and no further emergency response measures have been defined. As it is important that the operator and the public understand the possible extent of the hazard area, the Board will require that Cdn 88 work with parties within the EPZ to assure it is complete and that the public has an opportunity for input, to understand the content and to appreciate the nature of the follow up. The Board notes that Cdn 88 has addressed public safety beyond the 4-km EPZ in the draft ERP by way of the stringent ignition criteria and co-ordination of the plan with the MD. However, in this particular case, the Board believes that Cdn 88 should identify sensitive individuals within the 8-km awareness zone. The ERP should outline procedures to notify those designated as sensitive at a level 2 emergency and provide the option to evacuate and to evacuate all those who are sensitive if the well is ignited. These measures would provide sensitive individuals protection from any exposure to SO₂. Although the draft ERP does include SO₂ evacuation criteria, based on provincial criteria no procedures have been defined.

A common safety measure for a sour gas release is to ignite the gas. Igniting the well would convert the H₂S in the gas to SO₂ which would be more widely dispersed due to thermal rise and limit the public risk. The Board recognises that there is concern over the extent of the area which may be impacted by SO₂. However, it is the Board's judgement that SO₂ levels would not likely reach provincial evacuation levels and that procedures, including those noted above would be in place to assist those who may experience discomfort. Given the circumstance, the Board believes that any uncontrolled flow of sour gas should be ignited immediately to provide assurances that prompt action is taken and impacts are minimized. The Board expects the ERP to be modified to reflect this condition and to reflect the management protocol to implement the necessary actions.

The Board is confident that immediate ignition of a release is possible if the crew responsible is adequately trained, and that, once the well is ignited, it would remain burning due to the mixture of methane and H₂S. The Board notes that Cdn 88 has proposed redundant ignition equipment, including an automatic ignition system at the well site, an auxiliary automatic ignition system at the emergency control centre and a flare gun. While the Board is satisfied that the basic evacuation criteria proposed by Cdn 88 should be acceptable, it will require it to be tested to assure all individuals required to implement the evacuation are sufficiently familiar with the details. According to the draft plan, evacuation of the public within the EPZ would begin at a level 1 emergency and would be completed at a level 2 emergency before there is any risk of exposure to H₂S. The Board would expect Cdn 88 to identify and include in its ERP procedures to address special evacuation needs of the public.

With respect to evacuation of animals, protection of the public is of primary importance and should remain the focus of a site-specific ERP. Evacuation of animals may be possible at the early stages of a well control problem before a release occurs but only if it is safe to do so.

The Board considers Cdn 88's proposal to use the computerized telephone call out system to deliver emergency messages to be acceptable. It notes that the computerized messages would be followed up with telephone contact and a physical search of the area to ensure evacuation has taken place. The system should be in place and tested before the well is spudded to assure it performs as expected. With respect to ambient air quality monitoring, the Board believes that two mobile monitoring units stationed at the well site during drilling in the sour zones and the four stationary monitors located at sub-divisions beyond the 4-km zone would be adequate to detect and monitor H₂S and SO₂ levels in the event of an emergency.

The Board notes that effective emergency response protocols rely on the public to be knowledgeable about the event and to respond in an informed way to the measures taken. To do so, the ERP should be developed with assistance of the public and address reasonable concerns raised by them.

The Board believes that it is Cdn 88's responsibility to ensure that an adequate ERP is developed and in place to protect the public in the event of a well control emergency. The Board recognizes that such a plan would include responsibilities of other parties to work with the company personnel in responding. It is acceptable to and expected by the Board that the operator co-ordinates its plan with municipal and government plans. Local and provincial authorities also share responsibility for protection of the public and should have complementary plans in place to provide assistance. In this case, the MD has agreed to assume responsibility for emergency response measures beyond 4-km, although this agreement has not been finalized and does not eliminate Cdn 88's responsibility to provide assistance. The Board will need to be satisfied that adequate municipal and provincial resources would be available to assist the MD. The Board notes that the MD has acknowledged responsibility for protection of the public within its area of jurisdiction and must be prepared to respond regardless of the type of emergency. The Board expects the written agreement between Cdn 88 and the MD to be finalized and submitted to the Board prior to drilling if a licence is issued. The Board notes the concerns raised by the City and some agencies that large scale evacuation may be necessary in Calgary. Given the available information such actions are both unreasonable and unlikely.

The Board expects Cdn 88 to review details of the plan and update all information including resident information, mapping, emergency contacts and resources and submit the final plan to the Board for review and approval prior to drilling if a licence is issued.

The Board **also** believes that it would be necessary to test all procedures detailed in the ERP prior to drilling to ensure that response personnel are adequately trained and capable of carrying out responsibilities. The Board notes that no evidence was presented to suggest that Cdn 88 would not be capable of responding to an emergency, however, this is difficult to assess without testing the ERP. The Board expects Cdn 88 to test all key components of its ERP, including the chain of command, computerized telephone call out system, communications equipment, communications linkages including outside services, evacuation procedures, and ignition procedures and to satisfy the Board that the systems are in order for immediate implementation.

The Board expects Cdn 88 to implement a system of safety briefings for all individuals in the drilling operation to assure full knowledge of the ERP and the actions to be taken, in particular to matters relating to the ignition criteria.

LAND USE IMPACTS

The Board recognizes the exploratory nature of the proposed well and agrees that only a conceptual development plan is possible at this stage. The Board considers the plan to be adequate at this time. The Board further recognizes the difficulty in providing details with any degree of certainty. In the Board's view it is premature to determine the optimum development plan. The Board notes that all of the five existing, nearby processing facilities have the potential required spare gas capacity, but that only one has the spare sulphur capacity.

The proposed well is consistent with current land use zoning. Continued country-residential development will make it increasingly more difficult to locate facilities and pipelines in the future, so it is reasonable to determine the potential of the reserves now. Should the well be drilled and found to be commercial, the Board expects future developments to take into account the conflicting priority of resource recovery and residential growth.

As noted by Cdn 88, future developments will require separate applications and the Board will deal with them at that time. If this well proceeds and is successful, the information will allow the proponent to refine the definition of the resources. At that time a detailed development plan will need to be developed in consultation with the stakeholders, before additional wells or facilities may be considered by the Board.

PUBLIC CONSULTATION

The Board accepts that Cdn 88 provided information packages containing information about the well characteristics, its proposed location, and about the ERP. The Board notes that Cdn 88 attempted a door-to-door consultation program and held a public meeting to provide further information to the public. The Board believes that these types of public notification and consultation processes are necessary. However, the Board believes that proponents must recognize and evaluate the nature of a proposal, and the vast complexities and public unknowns associated with it in carrying out a satisfactory consultation program.

The Board notes the concerns of the interveners who, in most cases, believed that the information provided was misleading, difficult to understand, and left them with uninformed perceptions. The Board further notes that the interveners' attempts to obtain additional information to understand the details of the application, the technical basis and exact nature of the risks involved, proved to be frustrating, painstaking and time consuming. The interveners indicated that when information was provided, it was piecemeal, revised repeatedly and a constant moving target. The Board believes that proponents should be proactive in their attempts to assist the public to understand a

project, especially when the public has assembled a willingness to work with a proponent. The Board believes Cdn 88 would have greatly assisted the interveners and the Board by providing information in a more consistent, accurate and timely fashion, that would have helped the process to be more efficient leading up to the hearing.

The Board notes that the actions taken by Cdn 88 appear to have compromised the integrity of the company in the mind of the public. It left the interveners with little sense of security, and prompted a lack of trust. The Board notes that as a result, many of the interveners did not believe Cdn 88 would be a responsible operator able to ensure that the public safety issues could be met.

The Board accepts Cdn 88's stand that communication is a two-way street. The Board notes that in many cases during Cdn 88's notification and consultation process that there may have been an unwillingness by the public to participate in meaningful dialogue. However, the Board believes that the perception by the interveners of Cdn 88's unwillingness to understand the many different consultation needs of the public led to a polarization. The Board believes proponents need to be aware of these needs and be sympathetic in attempting to understand these needs.

The Board believes that appropriate notification and public consultation must be conducted well in advance of the submission of an application to the Board. It must be thorough enough to allow all parties who are or may be affected to be sufficiently aware of not only the proposed project, but the Board process as well. The Board believes that the public must have sufficient information to participate meaningfully in the decision-making process, to voice their concerns, have their concerns heard and properly addressed, and if possible, resolved. The proponent's information must be extensive, consistent, factual and disclosed in a timely way, and if the proposal is part of a larger project, the proponent should be prepared to discuss the entire project and to explain how its components complement other energy development plans in the area. Cdn 88 did not meet this level of public notification and consultation. The consequence was misapprehension of the risks, inflamed relationships, and an unnecessary anxiety. Given the conduct, the Board can only conclude that the Company is unable or unwilling to embrace the spirit of public consultation expected from operators in Alberta. In the Board's view the Company needs to expend considerable effort to rebuild the trust with the community or turn over the operation to others who have that trust.

DECISION

The Board believes that the public safety risks associated with the proposed well are representative of normal industrial risks accepted by society and that the well can be drilled safely. Additionally, the Board believes that these risks are similar to existing facilities and are acceptable if managed through strict adherence to the risk control measures required in the existing regulations. However, the Board is not satisfied that the public within the EPZ and associated awareness zone understand the ERP and how it would be executed. Very few individuals have seen and or have participated in an ERP exercise to understand its implementation, which the Board believes lead to the perceived risks by the public.

The Board is also concerned with the state of readiness of Cdn 88 to involve the county and others in implementing its ERP. The Board believes that Cdn 88 should carefully design and implement a process that would allow members of the public who are prepared to participate in completing the ERP do so in a meaningful way.

Given the above, and having considered all of the evidence, the Board is prepared to issue the well licence after Cdn 88 has undertaken, committed to, and will be submitting the following for Board review:

- 1) Cdn 88 shall develop documented management processes, including policies and procedures for equipment design, specification, procurement, construction and operations for drilling, completing and testing the well. An assessment of the effectiveness of the management processes shall be audited and endorsed by a suitably qualified third party before submission to the EUB.
- 2) Cdn 88 shall satisfy the Board that the equipment and procedures to be used by the contractors selected are suitable for the intended service for drilling, completing, and testing this well. Additionally, Cdn 88 is required to demonstrate to the Board that all personnel employed in this operation are experienced in sour gas drilling operations and hold the necessary certifications.
- 3) Cdn 88 shall develop a casing bowl welding procedure by a qualified professional engineer to be included in a detailed drilling plan.
- 4) Cdn 88 shall submit a report respecting the review of steel mill heat certificates for the casing and drill pipe to be used in the construction of the 10-35 well.
- 5) Cdn 88 shall satisfy the Board that ARP 1.2.5 New Grade E Specifications and/or ARP 1.2.6 SS-95 Drill Pipe Specifications or better will be used for the drilling of the 10-35 well.
- 6) Cdn 88 shall commit to daily briefings of the EUB Calgary South Field Centre, including submission of daily drilling reports during the critical period.
- 7) Cdn 88 shall notify EUB Field Surveillance personnel and have them attend pre-spud and pre-critical zones penetration safety meetings.
- 8) Cdn 88 shall commit to detailed EUB drilling rig inspections prior to spud, and drill out of intermediate casing, including blowout prevention drills.
- 9) Drilling and testing in the critical zone shall not take place other than during the summer months, in particular, not before April nor after October.
- 10) Cdn 88 shall demonstrate and implement immediate ignition within one minute of the ignition criteria being met.

- 11) Cdn 88 shall test all key components of its ERP, including the computerized telephone call out system, communications equipment, communications linkages including outside services, evacuation procedures, and ignition procedures and satisfy the Board that the systems are in order for immediate implementation, prior to drilling into the critical sour zone.
- 12) Cdn 88 and the MD shall identify sensitive individuals within the additional 4-km awareness zone. Additionally, Cdn 88 shall update its ERP to include procedures to notify those designated as sensitive at a level 2 emergency and provide the option to evacuate. All those who are sensitive must be evacuated if the well is ignited.
- 13) Cdn 88 will satisfy the Board that all individuals involved in implementing the ERP are familiar with the program and capable of implementing it as required. Cdn 88 shall alert the public included in the ERP on the progress of drilling each week until drilling and testing is complete.
- 14) Cdn 88 shall notify all individuals in the EPZ and awareness zone prior to drilling in the critical zone.
- 15) Cdn 88 shall provide two air mobile monitoring units stationed at the well site during drilling in the critical sour zone. The Board believes that these mobile air monitoring units and the four stationary monitors located at sub-divisions beyond the 4-km EPZ would be adequate to detect and monitor the level of H₂S and SO₂ in the event of an emergency.
- 16) Cdn 88 shall satisfy the Board that adequate municipal and provincial resources would be available to assist the MD for protection of the public within its area of jurisdiction. The Board must be satisfied that the MD is prepared to respond regardless of the type of emergency. The Board expects a written agreement between Cdn 88 and the MD to be finalized and submitted to the Board prior to drilling.
- 17) Cdn 88 shall review details of the ERP and update all information including resident information, mapping, emergency contacts and resources and submit the final plan to the Board for review and approval prior to drilling.
- 18) Cdn 88 shall work with all affected emergency planning organizations to prepare contingency plans in the event of an emergency.

END

ALBERTA ENERGY AND UTILITIES BOARD

Calgary Alberta

**CANADIAN 88 ENERGY CORP.
APPLICATION TO DRILL A LEVEL 4
CRITICAL SOUR GAS WELL
LOCHEND FIELD**

**Decision 99-16
Application No. 970473**

1 APPLICATION AND HEARING

Canadian 88 Energy Corp. (Cdn 88) applied, pursuant to section 2.020 of the Oil and Gas Conservation Regulations, for a licence to drill a level 4 critical sour gas well to be located at Legal Subdivision 10 of Section 35, Township 26, Range 3, West of the 5th Meridian (10-35 well).

Interim Directive (ID) 97-6¹ sets out some of the relevant regulatory restrictions for such wells. The level 4 designation is used to determine the minimum separation distance between the well and land-use surface developments during the suspended or producing stage. This 10-35 well would require a minimum separation distance of 100 metres (m) from any individual dwelling development with up to eight dwellings per quarter section, 500 m from an unrestricted country development, and 1500 m from an urban centre or public facility, as defined in ID 97-6.

The application and interventions were considered at a hearing in Calgary, Alberta commencing on 4 May 1998, before Board Members F. J. Mink, P.Eng., J. D. Dilay, P.Eng., and G. J. Miller. Those who appeared at the hearing are listed in the following table.

THOSE WHO APPEARED AT THE HEARING

Principals and Representatives
(Abbreviations Used in Report)

Witnesses

Canadian 88 Energy Corp. (Cdn 88)
A. L. McLarty

F. O. Ceh, C.E.T.
G. R. Gill, P.Eng.
G. T. Dowling
J. Kenny, P.Eng.
of ATECH Technologies Ltd.
J. K. Farries, P.Eng.
of Farries Engineering (1977) Ltd.
D. M. Leahey, Ph.D.
of Jacques Whitford Environment
Limited
R. E. Rogers, Ph.D., P.Biol.
of Toxcon Inc.

THOSE WHO APPEARED AT THE HEARING (cont'd)

¹ Interim Directive 97-6, *Sour Well Licensing and Drilling Requirements*

Principals and Representatives
(Abbreviations Used in Report)

Witnesses

Prize Energy Inc. (Prize)
S. Carscallen, Q.C.
G. D. Baker

Hutchinson, Robertson, and Reilly Families
(the Families Group)
S. M. Munro

K. Robertson
P. Hutchinson

Turner Family (the Turners)
S. K. Luft

R. Turner
D. J. Turner

Calgary North H₂S Action Committee
(the Committee)
S. Dunnigan

P. C. Jackson, P.Geol.
K. Smith
I. Dowsett, R.E.T.
of Conor Pacific Environmental
Technologies Inc.
W.A.J. Springer, P.Eng.
of Conor Pacific Environmental
Technologies Inc.

Lochend sour Gas Emergency Zone Coalition
(the Coalition)
G. E. Kruk

B. Wallz
W. Rusel
R B. Baguley, P.Eng.
T. Gibson
of Gecko Management Consultants
Corporation
J. Hemstock
of Gecko Management Consultants
Corporation

City of Calgary (the City)
T. Brown

THOSE WHO APPEARED AT THE HEARING (cont'd)

Principals and Representatives (Abbreviations Used in Report)	Witnesses
Calgary Regional Health Authority (CRHA) C. Pim, M.D.	D. Stefani, B.Sc. T. Lambert, Ph.D.
Municipal District of Rocky View No. 44 (the MD) P. M. Kivisto	L. Stevens, C.E.T. J. P. Graham
D. H. MacFarlane G. Vincent	D. H. MacFarlane
The Locke Family (the Lockes) C. Locke	L. Locke
R. Goodhart	R. Goodhart
Alberta Energy and Utilities Board staff R. D. Heggie, Board Counsel D. F. Brezina, Board Counsel P. R. Forbes, C.E.T. M. S. Craig M. E. Connelly, P.Geol. M. J. Zelensky, P.Eng. H. W. Knox, P.Eng.	

The following parties registered as participants at the hearing but did not present evidence, conduct cross-examination, or present closing arguments:

- L. Fedor for Butterfield Acres Farm, represented by the Committee
- D. David, represented by the Committee
- S. Gordon, represented by the Committee
- R. Hunt, represented by the Committee
- S. Pollock-Eddy, represented by the Committee
- O. Johnson
- W. Murray
- R. Kaufman, represented by the Committee

The location of the proposed well, emergency planning and awareness zones, and potential Lochend Field are shown on Figures 1 and 2.

2 ISSUES

The Board considers the issues respecting the application to be:

- need for the well
- proposed location of the well
- potential H₂S release rate
- drilling and completion considerations
- public safety risk assessment
- emergency preparedness
- land use impacts
- public consultation

3 NEED FOR THE WELL

3.1 Views of Cdn 88

Cdn 88 submitted that it had leased the freehold mineral rights underlying Section 35-26-3 W5M from the Turners. By virtue of the lease, it had the right to explore for and develop those mineral interests, on behalf of its 50 per cent partner, Canadian Occidental Petroleum Ltd. (CdnOxy), and its five per cent working-interest partner, Prize.

3.2 Views of the Interveners

Prize submitted that the application should be approved to enable the working interest owners of the potential natural gas resources to enjoy their property rights and to enable the Province of Alberta to enjoy the substantial financial rewards that would accrue to it should the proposed well prove to be successful.

The Families Group submitted that, as owners of mineral interests in the Lochend district, it supported the production of oil and gas resources in the area. It submitted that ownership of mineral title must include the right to work those minerals, otherwise such ownership would be rendered meaningless.

The Turners, as owners of the natural gas rights underlying the subject lease, submitted that denial of the application would unfairly sterilize exploration and production of their natural gas interests, thereby depriving them of an asset which, as a family, they have worked for over 70 years to maintain.

The Lockes questioned the need for this sour gas well and submitted that, although Albertans need and want oil and gas, this alone should in no way suggest that approval should be given to every initiative. The Lockes further questioned the relationship of “need” to the exercise of property rights.

The Committee submitted that any impact of denying the well licence should be absorbed by the mineral lease owners and lessees.

The Coalition said that there could be compensation to the mineral rights owners for their loss of potential revenues.

None of the other interveners disputed the need for the well or Cdn 88's right to exploit its minerals.

3.3 Views of the Board

The Board notes that, while a number of parties argued against the development because of its public health and safety aspects, there was little dispute about the need for the well and Cdn 88's right to recover the natural gas underlying Section 35-26-3 W5M. The Board acknowledges that the ability to exercise property rights are a compelling component of determining need for the well unless other public interest issues related to the development are of overriding interest. The Board accepts Cdn 88's right to explore for its gas resources in the Lochend area and accepts that, provided the development can be carried out in an acceptable fashion, there is a need for the well.

4 PROPOSED LOCATION OF THE WELL

4.1 Views of Cdn 88

Cdn 88 submitted that the proposed well is a 3800-m Elk Point test with the main objective being the Devonian Swan Hills Formation. Cdn 88 expected the Swan Hills reservoir to contain wet sour gas, similar to the Caroline Beaverhill Lake A pool located some 66 kilometres (km) to the north. This prospect would be located on the Swan Hills bank margin and would be situated approximately four km south west of CdnOxy et al Lochend 8-13-27-3 W5M, which encountered basinal equivalent to the Swan Hills member. It estimated that the chance of a successful well was one in ten.

Cdn 88 anticipated hydrocarbons of similar composition to the Caroline Beaverhill Lake A pool to be stratigraphically trapped due to the up-dip transition from porous dolomite of the Swan Hills Reef to tight limestone and shales of the Beaverhill Lake Waterways Formation. Cdn 88 submitted that the proposed 10-35 well may encounter similar parameters to the Shell Canada Limited (Shell) Caroline wells.

Cdn 88 did not anticipate the presence of sour hydrocarbons in the overlying formations and expected the Leduc, Nisku, Wabamun, and Mississippian formations to be either wet or tight. Cdn 88 identified this exploratory play through seismic data and geological interpretation. It proposed to drill the 10-35 well on a seismic shot point to test the strongest seismic porosity anomaly. Cdn 88 interpreted that the structure lessens north of the location, and possibly south.

Cdn 88 said that it had identified what it believed to be a subsurface location that had the greatest potential for success. It stated that moving the well off of this location in any direction by any distance would have the effect of making the chance for success of this well less likely. Additionally, Cdn 88 argued that, if it drilled a different location and the well proved unsuccessful, it would very likely only defer the inevitable need to explore the proposed location.

Cdn 88 also rejected directionally drilling the well from a surface location a few hundred metres from the proposed location due to additional length and complexity of the drilling operation, and the fact that the Turners, the surface owners, were satisfied with the applied-for surface location. Cdn 88 submitted that the proposed location was the optimal location from the perspective of both minimizing the risk to public safety, and enhancing the chance for a successful well.

4.2 Views of the Interveners

The Turners, the surface owners, supported the location of the proposed well.

The Committee was concerned with the proposed well location on the basis that it was adjacent to population in creek valleys. The Committee estimated that there were 59 occupied residences, containing a total of 190 persons within the proposed four-km emergency planning zone (EPZ). It estimated that an additional 963 persons in the eight-km awareness zone, in excess of 10 000 persons between the eight-km zone and the City of Calgary, and the population of Calgary itself, would all be potentially affected by the proposed well. In addition, the proposed location was situated in the broad upper area of the West Nose Creek valley which provided a narrowing straight line conduit (funnel) south east into Calgary.

The Coalition expressed concern that the location of the proposed well would adversely affect the property values of Coalition members. It stated that the market value of the country residential properties in the vicinity of this proposed well is, in large part, based on aesthetic considerations, recreational use, solitude, community reputation, and the combination of relative remoteness from disruptive industrial operations and proximity to the social amenities of Calgary. The intrusion of sour gas facilities into the area would undermine these property attributes.

The other interveners did not express concerns with the specific location of the proposed well.

4.3 Views of the Board

The Board notes that Cdn 88 identified the proposed location seismically and that it identified it as its optimum location providing the greatest chance for success of its exploratory well, matters not disputed by the other parties. The Board also notes that the surface owners were satisfied with the location of the proposed well. While other interveners considered other surface locations to be more appropriate, the Board is satisfied the proposed location meets or exceeds the normal requirements for siting of such wells. The concerns about siting of the well raised by the interveners related largely to impacts and risk of personal safety which are discussed in some detail later in the decision.

5 POTENTIAL H₂S RELEASE RATE

5.1 Views of Cdn 88

Cdn 88 initially estimated the potential hydrogen sulphide (H₂S) release rate for the proposed well to be 16.05 cubic metres per second (m³/s) based on data from the analog Caroline Beaverhill Lake A pool, the average raw gas analysis and the sandface absolute open flow (AOF) rate from the well having the highest raw values in the southern portion of the pool. Subsequently, Cdn 88 reassessed this release rate, recognizing that a sandface AOF rate was not

realizable at the wellhead due to friction losses in the wellbore, and that a wellhead AOF rate was a more realistic representation of surface release. As a result, Cdn 88 re-examined the sandface and wellhead deliverability potential of the Swan Hills sour gas production in the Caroline Field and the likely composition of such gas. In its evaluation of the production test data from this formation, sufficient pressure and flow data to do a thorough analysis was found for only three wells in the Caroline Field. Only one of these wells had a sandface AOF in the EUB records. On the basis of its analysis of the data from these three wells, the wellhead AOF rates ranged from 1870 to 2450 $10^3 \text{ m}^3/\text{d}$. These wellhead AOF rates were determined assuming the well was cased with no other tubulars in the hole, representing the wellbore conditions that would exist during drilling. Cdn 88 opted to use a rate of 2266 $10^3 \text{ m}^3/\text{d}$, based on the one available Alberta Energy and Utilities Board (EUB) sandface AOF of 3556 $10^3 \text{ m}^3/\text{d}$, as the most reasonable AOF rate that could be encountered by the proposed well.

In the view of Cdn 88 these three wells also provided sufficient field test data to accurately determine H_2S concentrations, such as the composition of the separator gas and liquids, flow rates and separator pressure and temperature. It noted that Shell had performed recombination analyses of these three wells in 1995. Similar analyses were performed by Cdn 88 on two of the wells, essentially confirming Shell's results. These compositional analyses indicated between 33 and 34 per cent H_2S for the Caroline Beaverhill Lake A Pool. Cdn 88 considered that these assessments were significantly more reliable than the H_2S content taken from uncontrolled raw data.

Given the above, Cdn 88 expected the H_2S release rate to be 8.9 m^3/s using a wellhead AOF rate of 2266 $10^3 \text{ m}^3/\text{d}$ and an H_2S concentration of 33.9 per cent. Cdn 88 submitted that 8.9 m^3/s was a more realistic H_2S release rate than the 16.05 m^3/s rate derived from sandface flows and raw composition data.

5.2 Views of the Interveners

The Committee expressed concern with statements made in Cdn 88's application and in other communication to the community that the proposed well was no more hazardous than other wells in the Calgary area. It also had concerns with Cdn 88's presentation of both potential release rates and H_2S concentrations in a series of documents.

The Committee noted that the sour gas wells in the Calgary area produced gas at lower rates and H_2S concentrations than the analog Caroline Beaverhill Lake A Pool. The Caroline-type well was a far more serious type of well and close to the top of the critical level 4 sour gas well classification. It believed that the statements made by Cdn 88 that the proposed well would be comparable to wells previously drilled in the Calgary area were not accurate and misled area residents into underestimating the risk associated with the well.

With respect to the H_2S release rates, the Committee submitted that its expert's review of the 84 gas tests in the 15 wells at Caroline found 24 tests with H_2S concentrations greater than 45 per cent, with seven of those over 50 per cent, the maximum being 59 per cent. There were also a large number in the low 40 per cent range. From this, the Committee concluded that Cdn 88's documents did not represent the range of H_2S concentrations that might be encountered at the proposed well. The Committee recommended that an H_2S concentration of at least 50 per cent would be a realistic upper level that would provide a safety cushion. The Committee also looked at the sandface AOF rates from the Caroline wells and determined the maximum to be

3663 $10^3\text{m}^3/\text{d}$. It estimated that, using this data, the reasonable worst case H_2S release rate would be $21.0\text{ m}^3/\text{s}$.

The Committee stated that using a sandface, instead of a wellhead, AOF rate provided for a margin of error. It explained that it was typically assumed that the highest flow rate from a pool would be the maximum capability that could be obtained from that pool. By using a sandface AOF rate, a cushion would be available should that assumption be incorrect. The Committee also stated that, even if wellhead rates were used, the maximum determined wellhead rate is the most reasonable. The Committee disagreed with Cdn 88's use of an average wellhead AOF rate. It suggested that, even using Cdn 88's maximum wellhead AOF rate and the more realistic 50 per cent H_2S concentration, the resulting H_2S release rate would be $14.5\text{ m}^3/\text{s}$.

CRHA accepted Cdn 88's revised estimates of expected flow rate and H_2S concentrations.

The Lockes submitted that it would be more prudent to use reasonable worst-case projections to estimate the potential H_2S release rate. They suggested that whatever values were used should be based on a very high degree of caution.

5.3 Views of the Board

The Board recognizes that determining the H_2S release rate is an important element in preparing for and drilling critical sour wells in a safe manner. Implied in the process is identifying parameters that could realistically be encountered in the operation. The Board's expectations are clearly stated in ID 97-6 and are repeated below:

- the maximum concentration that can be expected and the source of that information
- the maximum surface deliverability that can be expected against zero back pressure for casing or open-hole flow configuration
- the methodology used to determine the above

The Board accepts the Caroline Beaverhill Lake A Pool as a reasonable analog to be used for the proposed Lochend well. The Board notes that H_2S concentrations as high as 59 per cent are on record for the analog pool. However, many of these concentrations, specifically those greater than 34 per cent, were obtained from samples of separated well streams and are not representative of the reservoir fluid. The H_2S concentration in the wellbore fluid of 33.9 per cent used by Cdn 88 is acceptable to the Board.

The use of wellhead deliverability, instead of sandface deliverability, is more realistic and is an acceptable approach as dictated by ID 97-6. The Board notes that Cdn 88 did not use the maximum surface deliverability of the three similar wells, but rather used the wellhead rate based on the one sandface rate available in the EUB records for the three similar wells. Given that the maximum surface deliverability of the three similar wells of $2450\text{ }10^3\text{m}^3/\text{d}$ is only about eight per cent greater than the flow of $2266\text{ }10^3\text{m}^3/\text{d}$ used by Cdn 88, the Board considers Cdn 88's estimate to be a reasonable representation of the maximum surface deliverability. The Board cannot accept that exaggerated levels of H_2S that cannot be reasonably substantiated in the fluid should be incorporated into the evaluation. In summary, the Board accepts the methodology presented by Cdn 88 in evaluating the potential H_2S release rate.

6 DRILLING AND COMPLETION CONSIDERATIONS

6.1 Views of Cdn 88

Cdn 88 stated that the drilling and safety program that it established for the 10-35 well would ensure that it was drilled safely and without hazard to any member of the public.

Cdn 88 stated that the Alberta petroleum industry is a world leader in the development and use of sour-gas drilling and production technology, and that it is currently one of the most active and experienced explorers drilling deep foothills sour gas wells in Alberta. It intended to drill the 10-35 well with up-to-date sour-gas technology, drilling procedures, and safety systems operated by experienced personnel. In support of its application, it submitted a drilling plan outlining equipment requirements, materials, procedures, and personnel for the various operations throughout the drilling of the well. It stated that it would meet EUB requirements as set out in ID 97-6, and follow the Alberta Recommended Practices (ARPs) for Drilling Critical Sour Wells while drilling the 10-35 well, in particular during the critical period while the Swan Hills Formation was open to the wellbore. It advised that the proposed blowout preventer stack would include shear blind rams, enabling it to cut the drill pipe if that became necessary to close in the well. It also indicated that the critical period would be about 10-14 days in duration during which there would be increased supervision and safety personnel on location, as well as additional well monitoring and safety equipment. The additional safety equipment would include remote controlled ignition equipment. The drilling program would consist of drilling the surface hole to about 440 m, at which point 339.7-millimetre (mm) diameter surface casing would be run and cemented to surface. Then the intermediate main hole would be drilled to the top of the Cooking Lake Formation at about 3630 m. After evaluating the intermediate main hole for potential hydrocarbon-bearing strata using open hole logs, 177.8-mm diameter intermediate casing would be run and cemented in stages to ensure zonal isolation and protection of useable waters. Lastly, the main hole below the intermediate casing would be drilled to the Swan Hills Formation at a total depth of about 3860 m. After evaluating the main hole using open hole logs, a 114.3-mm diameter production liner would then be tied back inside the 177.8-mm diameter intermediate casing and cemented in place. Cdn 88 commented that, after the intermediate casing was cemented in place, it would have the ability to effect a “hard” shut in through the immediate closure of the blowout preventers should any of the monitors indicate an influx of fluid or a “kick” into the well during the critical period.

With respect to its request to reduce the surface casing setting depth from 450 to 440 m, Cdn 88 said that it had selected 450 m when it filed its application based on an initial review of offset wells in the area. Subsequently, during a more detailed review, it determined a lesser amount, some 368 m, would be necessary with intermediate casing to be set at 3630 m. Its review of drilling problems recorded for other wells drilled in the area indicated that minor lost circulation had been experienced with some wells during the drilling of surface hole, but no gas influxes were encountered. Cdn 88 stated that it decided to request the setting depth be reduced to 440 m to avoid being required to install a diverter during the drilling of surface hole. It noted that, while some cost savings during the drilling of surface hole would be realized as a result, sour gas would not be encountered during the drilling of surface hole in any event.

Cdn 88 advised that the potential for lost circulation during the drilling of the intermediate main hole would be unlikely. Its investigations found the minor occurrence at 3176 m on the nearby abandoned 8-13-27-3W5M well was due to an error in not maintaining the hole full of drilling

mud/fluid while tripping pipe. A second occurrence, reported as minor lost circulation in the Cooking Lake Formation at about 3627 m was the result of excessive hydrostatic pressure during cementing of the intermediate casing. It believed that its drilling procedures, including the stage cementing of the intermediate casing, will minimize any potential lost circulation, and accordingly, it did not expect to encounter lost circulation problems while drilling the 10-35 well.

Notwithstanding, it noted that materials to combat any lost circulation would be readily available on site in any event. It also noted that the intermediate casing would be run and cemented before drilling into the Swan Hills Formation.

Cdn 88 also responded to concerns about its management process and liability in case of an unexpected event at the site. Cdn 88 advised that its drilling manager was responsible for management processes and procedures to ensure that the materials, equipment, and personnel to be utilized for the drilling of the 10-35 well meet or exceed the minimum regulatory requirements.

Cdn 88 said that it had \$30 million liability insurance in addition to \$20 million blowout insurance for the 10-35 well.

While Cdn 88 emphasized that its application was only for a licence to drill the 10-35 exploratory well, it indicated that, if it were successful, some flaring would be required during the completion stage to evaluate the performance. It noted that it would be required to obtain a flare permit in order to undertake any testing, and an emergency response plan would need to be in place for that operation. Cdn 88 said that after a successful evaluation, it would suspend the well with a down hole packer and tubing, two down hole tubing plugs, water in the annulus between the casing and tubing, and a subsurface safety valve. The wellhead would be plugged, chained and locked, with physical barriers installed to protect it from accidental damage. When questioned about possible sabotage, Cdn 88 maintained that, short of maintaining 24-hour manned security, the well safety design and operating measures used by industry were reasonable and adequate.

6.2 View of the Interveners

The Committee questioned Cdn 88's review of drilling problems encountered while drilling offset wells, as well as Cdn 88's request to reduce the depth of surface casing. It noted that Cdn 88's drilling plan did not specifically address the lost circulation reported during the drilling of the 8-13-27-03W5M well. The Committee's submission also provided a summary of EUB drilling and production inspection information for other Cdn 88 operations and included a number of suggested safety-related items for consideration. The Committee advised that it would prefer the well to be relocated as a first step to prevent potential lethal impact of an H₂S emission on densely populated areas. Although slimhole drilling was suggested as a way to reduce flow, and thereby reduce the associated risk, the Committee agreed that it would not want to compromise drilling safety by reducing the size of the hole drilled. The Committee also suggested that the overall risk could be reduced through restricting the number of wells drilled as well as the production rate by equipping any wells drilled and completed with smaller diameter tubing. When questioned about its proposal that wells be tested into a pipeline to eliminate flaring, the Committee advised that this consideration would not necessarily apply just to the

10-35 location, but rather was a general statement to encourage emissions reductions in any situation where testing into a pipeline is available. It commented that meeting or exceeding Board testing guidelines would be acceptable to it.

Mr. Baguley, on behalf of the Coalition, expressed concerns regarding Cdn 88's management processes for equipment design, specification, procurement, construction, and operations. He specifically questioned the adequacy of the surface casing bowl welding procedure proposed by Cdn 88, citing it as an example of not meeting the minimum requirements. However, he was unaware of any surface casing bowl weld failures resulting in any well control related problems. While Mr. Baguley recognized the extensive sour gas drilling safety-related requirements and recommended practices developed by industry and government, he expressed concern about Cdn 88's ability to actually meet them. He suggested that the Board require third-party engineering audits, or the dedication of EUB technical personnel to verify compliance with all applicable requirements, should it decide to approve the 10-35 well. He stated that hydrogen-induced cracking (HIC) tested pipe should be used to construct the production pipeline if the well were successful.

Mr. Goodhart believed that the risk of vandalism is of a magnitude higher than truly accidental risk and that, should the well be approved, additional precautions to address vandalism must be taken, such as the installation of improved downhole protective devices. He also suggested other precautions to minimize the impact to adjacent residents, such as break resistant windows, remote shutdown of house ventilation systems in the event of a release, and the control of potential ignition sources to reduce impacts to houses in potentially explosive concentration situations.

Mrs. Locke also expressed concern about Cdn 88's ability to undertake the drilling operation. She noted that her concern stems from a lack of trust resulting from her belief that she had been deliberately and seriously misled by Cdn 88 during its first contact with her about the 10-35 well.

The MD requested that Cdn 88 and the EUB ensure that the highest standards of safety are maintained in all phases of the drilling and operation of the 10-35 well, and that the most technologically advanced drilling, operations, and safety equipment and procedures be implemented.

6.3 Views of the Board

The Board believes that the practices and procedures used during the drilling of any well, in particular a critical sour well, are integral to ensuring public and environmental safety. In this respect, it is generally satisfied that its requirements as detailed in ID 97-6 are adequate. The Board notes the importance of the ARPs for Drilling Critical Sour Wells to provide sound guidance to licensees. The current requirements and recommended practices were developed in response to the 1982 Lodgepole blowout with great care and effort, and reflect the importance placed on safe drilling operations and contingency planning to prevent or respond to inadvertent events. The Board believes that the requirements and recommended practices expected from industry since then have contributed significantly to safe sour gas drilling and operation within the industry.

The Board notes that Cdn 88 is an active explorer of sour gas reserves in Alberta, and it is aware that Cdn 88 has drilled numerous sour gas wells. While it notes Cdn 88's statements of intent to meet or exceed EUB requirements and implement industry recommended practices, it recognizes that concerns were expressed about Cdn 88's ability to effectively undertake the drilling plan for the proposed 10-35 well. The Board is alarmed at the lack of trust in the company to fulfill its obligations under the regulations.

Regarding the need for a diverter system to be installed during the drilling of the surface hole, the Board notes that the purpose of a diverter system is to redirect fluids from the well in the event of a fluid influx into the wellbore. The Board accepts Cdn 88's conclusion that a diverter is not required, and it is satisfied that 440 m of surface casing is sufficient for the drilling of the intermediate main hole.

The Board notes that, while a minor occurrence of lost circulation at depths where Cdn 88 would be drilling the intermediate main hole was reported from the nearby offset 8-13-27-03W5M well, the well was successfully drilled, cased, and cemented. Accordingly, the Board is satisfied that the provision for materials as identified by Cdn 88 to address potential lost circulation is adequate for the 10-35 well.

With respect to completion and testing of the 10-35 well, the Board would, as Cdn 88 noted, require a new application before any well testing could proceed. While it agrees with the Committee's suggestion that sour well testing should be done into a pipeline where possible, it believes that testing could proceed if done in accordance with EUB guidelines. Respecting suspension of the well, the Board is satisfied that the measures Cdn 88 plans to take to suspend the 10-35 well safely represent acceptable industry practice. The Board recognizes Mr. Goodhart's concerns respecting vandalism of oil and gas facilities, however, it believes the risk to be very low. Notwithstanding, the Board recognizes the important role of appropriate emergency response plans should a release of sour gas occur for any reason.

The Board notes the specific concerns raised by the Coalition about Cdn 88's casing bowl welding procedure, as well as the more general concerns related to Cdn 88's management processes for equipment design, specification, procurement, construction, and operations. Respecting the issues related to the casing bowl, the Board notes that it would play a reduced role in well containment after intermediate casing has been run, and that there was no evidence presented indicating overall industry problems related to surface casing bowl weld failures. However, it believes that appropriate welding procedures must be employed to maintain the highest wellbore integrity possible. Respecting the management processes used by Cdn 88 for equipment design, specification, procurement, construction and operations, the Board accepts that Cdn 88 has completed numerous sour gas wells in the recent past. However, it is not satisfied with Cdn 88's general response that these matters were simply the responsibility of its drilling manager. It believes that these processes are integral to successful implementation of the regulatory requirements and that Cdn 88 should more clearly demonstrate and communicate industry practices to the public. In view of this general concern respecting materials selection, and given its importance to overall wellbore integrity, both during drilling operations and any subsequent production operations, the Board believes it would be prudent to review the steel mill certificates specific to the casing and drill pipe to be used. Additionally, while it notes Cdn 88 plans to qualify existing drill pipe in accordance with ARP 1.2.3, it believes that drill pipe

meeting the requirements of ARP 1.2.5 New Grade E Specifications and/or ARP 1.2.6 SS-95 Drill Pipe Specifications would further reduce operational risk, and therefore, would specify it for the drilling of the 10-35 well, if approved.

In general, respecting drilling, completion and production matters, the Board is satisfied that the equipment and procedures proposed by Cdn 88 to drill the 10-35 well are consistent with regulatory standards including the APR for Drilling Critical Sour Wells. However, in recognition of the sensitivity of the location as demonstrated by the concern of the nearby residents about Cdn 88's abilities to undertake safe drilling operations, the Board would require the following if it were to grant a licence for the 10-35 well:

1. Develop and document the management processes, including policies and procedures for equipment design, specification, procurement, construction and operations, including an assessment of the effectiveness of them by a suitably qualified third party.
2. Confirm the aforementioned management processes are applied and demonstrate clearly that the equipment and procedures to be used by the contractors selected are suitable for the intended service. Additionally, Cdn 88 would be required to demonstrate to the EUB that all personnel employed in the drilling operation are experienced in sour gas drilling operations and hold the necessary certifications.
3. Develop and document a casing bowl welding procedure by a qualified professional engineer to be included in its detailed drilling plan.
4. Submission of a report respecting the review of steel mill heat certificates for the casing and drill pipe to be used in the construction of the 10-35 well.
5. Drill pipe meeting the requirements of ARP 1.2.5 New Grade E Specifications and/or ARP 1.2.6 SS-95 Drill Pipe Specifications or better be used for the drilling of the 10-35 well.
6. Daily communication with the EUB Calgary South Field Centre, including submission of daily drilling reports during the critical period.
7. Attendance by EUB Field Surveillance personnel at pre-spud and pre-critical zones penetration safety meetings.

In addition to Cdn 88 having to meet the above conditions, the EUB would carry out detailed EUB drilling rig inspections prior to spud, and drill out of intermediate casing, including blowout prevention drills.

7 PUBLIC SAFETY RISK ASSESSMENT

Issues considered in reviewing the public safety risk assessment are:

1. purpose and approach
2. source characterization
3. frequency of uncontrolled sour gas releases

4. consequence modelling
5. risk evaluation

7.1 Views of Cdn 88

Purpose and Approach

Cdn 88 stated that the purpose of doing the risk assessment was to establish the extent of the plume dispersion for sulphur dioxide (SO₂) and H₂S in order to evaluate the safety of a given facility compared to other hazardous events with which people are more familiar.

It submitted two H₂S risk assessments and two SO₂ air quality assessments for the proposed well. It considered the H₂S risk reports to be screening-level assessments. Cdn 88 referenced EUB-published documents to justify the approach and input assumptions but it also noted several deviations from EUB documents. Cdn 88 used expected values of parameters rather than worst-case values. It then applied a safety factor of 10 to 100 to the results at the risk evaluation stage to determine if the risks were acceptable and if more detailed studies were necessary. Cdn 88 considered the SO₂ air quality reports to be detailed assessments.

Source Characterization

Cdn 88 used different sour gas compositions in each series of H₂S and SO₂ studies. Initially it modelled a lighter-than-air mixture consisting of H₂S and methane, then it modelled a heavier-than-air mixture of H₂S, carbon dioxide, methane and heavier hydrocarbons. Cdn 88 used GASCON2, a neutrally-boyant dispersion model, for the lighter-than-air mixture, and SLAB, a dense gas dispersion model for the heavier-than-air mixture. The input to the SLAB model did not include condensed liquids for the assumed release temperature and atmospheric pressure. Cdn 88 acknowledged that the heavier-than-air mixture is more representative of a potential release composition.

Frequency of Uncontrolled Sour Gas Releases

Cdn 88 used EUB blowout data from 1975-1993 to estimate the chance of a blowout while drilling, producing, and servicing a sour gas well. It adjusted the blowout probabilities by multiplying by a critical well factor of 0.25 to account for various safety aspects not incorporated in the blowout data. For example, operators drilling critical wells are required by regulation to provide a drilling plan, install a blowout prevention device, perform regular inspections, incorporate kick detection, and monitor for H₂S. They are also obliged to use drill string valves and high-quality drill pipe, install intermediate casing, and ensure that trained and certified personnel capable of responding to potential releases are working on the drilling crew.

Cdn 88 applied an annualization factor to account for the amount of time that would be spent in the sour zone while drilling, or servicing. Cdn 88 maintained this adjustment is appropriate given that the public is only at risk while Cdn 88 is drilling in the sour zone. It noted that this was also done in the Advisory Committee study². Cdn 88 submitted that the annualization factor should be 4/52 for drilling operations to allow for two weeks in the sour zone during both the drilling

2 Advisory Committee to the ERCB Reviewing Public Safety and Sour Gas, February 1994.

and completion phases of the well. For servicing, Cdn 88 submitted that an annualization factor of 2/52 should be applied to account for two weeks of servicing per year. It was noted that this was not done in the Advisory Committee study, but Cdn 88 thought it should have been done. Cdn 88 made no adjustment to the annual production well release frequency.

Cdn 88 also recognized there could be a small probability that the well could not be ignited when an attempt is made which would result in a sour gas release. To account for that possibility, Cdn 88 multiplied the drilling release frequency by the probability of non-ignition of about one in a hundred. In the risk assessment reports, Cdn 88 stated that it would take 30 minutes for an uncontrolled release of sour gas to be ignited. During cross-examination, it clarified that it assumed immediate attempts at ignition, but that it modelled the exposure to sour gas as 30 minutes until the release was finally ignited. Cdn 88's estimates of the amount of time an uncontrolled sour gas release would occur before it is successfully ignited range from less than a minute to up to six minutes. Cdn 88 stated that it would agree to a condition of approval requiring that it demonstrate that the rig could be evacuated and the sour gas release ignited within one minute.

Cdn 88 proposed to also have a back-up igniter system available during servicing, which would reduce the probability of non-ignition to about one in a thousand. In the risk estimate calculations, it assumed immediate ignition but the risk assessment reports stated that it would take 30 minutes for an uncontrolled release of sour gas to be ignited during servicing.

Consequence Modelling

Cdn 88 used two methods to determine the consequences of sour gas exposure. The first method, a probit approach, relates the toxic load of an exposure to the probability of lethality. Cdn 88 stated that it used unshifted Rijnmond probit parameters for an average individual to allow comparison of lethality-based risk criteria and risks of day-to-day living for an average person. Cdn 88 stated that fundamentally it did not take issue with the use of the triple-shifted Rijnmond parameters which would address not only lethality but also the chances of suffering serious, irreversible health effects. The triple-shifted Rijnmond curve would be a more conservative estimation of lethality in the general population than the unshifted parameters and an adequate estimation of lethality in the subpopulation of sensitive individuals. Further, Cdn 88 noted that the triple-shifted Rijnmond parameters had been made more conservative than unshifted Rijnmond parameters, to reflect experiences from industrial accidents involving sour gas. It also clarified that the probit approach is for lethal, not sub-lethal, effects.

The second method was based on a threshold concentration of 500 ppm H₂S. Cdn 88 considered this concentration to be conservative as the lowest reported lethal concentration for a half-hour exposure was 600 ppm. This second approach was used because the SLAB model does not incorporate the probit approach calculations directly, therefore consequences were estimated using the threshold approach. Cdn 88 considered this to be acceptable for a screening assessment of the potential risk. Cdn 88 also indicated that it had estimated the consequences and risk using the probit approach with the triple-shifted Rijnmond parameters on the SLAB model output. Although, it did not submit them as part of the proceedings, it found that the facility was very safe regardless of what probit application was applied.

CRHA identified lethal concentrations of less than 500 ppm in the literature (Agency for Toxic Substances and Disease Registry (ATSDR) 1997 toxicological profile on H₂S). Upon investigation, Cdn 88 concluded that in each of the four cases identified, there were significant uncertainties as to the actual exposure concentration during the lethal exposure, and therefore, lethal concentrations less than 500 ppm cannot be supported with any degree of certainty.

At the intervener's request, Cdn 88 had provided isopleths that showed predicted outdoor H₂S levels of 100 ppm extending 16 km downwind using the SLAB model under poor dispersion conditions for a 30-minute sour gas release duration. Cdn 88 acknowledged that the contours provided were not the worst-case dispersion conditions. Cdn 88 predicted outdoor lethal zones extending eight km and the indoor lethal zones reaching 4.4 km based on the SLAB risk assessment. The lethal zone is defined as the downwind distance to a probability of lethality of one per cent.

With respect to SO₂, Cdn 88 showed that predicted SO₂ concentrations did not exceed the evacuation guideline outside of its proposed EPZ of four km.

Risk Evaluation

Cdn 88 provided estimates using the probit and the threshold approach for consequence analysis. Cdn 88 believed that, the risk does not change at the wellhead. However, it noted that the triple-shifted Rijnmond parameters resulted in increasing risk estimates relative to the unshifted Rijnmond parameters, as distance from the well increased. The heavier-than-air mixture results using the threshold approach resulted in the highest estimates.

Cdn 88 concluded that its studies show that the maximum individual risks associated with drilling this well are 0.014 chances in a million per year of fatality. It deemed this risk to be negligible when compared to a maximum acceptable risk in the order of 100 chances in a million. Cdn 88 suggested that the Advisory Committee considered this level of individual risk to be acceptable. Cdn 88 also maintained that the four-km EPZ was justified on the basis that predicted risk levels beyond four km are less than one chance in a billion of a fatality per year.

7.2 Views of the Intervenors

Purpose and Approach

The Committee believed that risk assessments should be done for several purposes. Firstly, they should be done to understand the nature and the extent of the risk and the factors that predominate the risk in order to understand what things could be done to minimize that risk, if possible. Secondly, hazard assessments should be done to define the maximum hazardous release in order to aid in developing an effective Emergency Response Plan (ERP). The Committee maintained that the risks of this proposed development should be compared to other similar risks that are in place, and that the information should be presented in a fashion that could be readily understood. The Committee referenced various EUB published documents in reviewing Cdn 88's risk assessment.

CRHA rejected Cdn 88's premise that risk assessment be based on "the probability of death from this activity." Alternatively, CRHA argued that to adequately assess the health risks to the population in its jurisdiction, required a detailed risk analysis and comparison of the various aspects of the application that may contribute to a well blowout and subsequent harm to the population. CRHA did not consider the risk assessments offered in evidence to be screening-level since the inputs utilized are clearly not worst-case. It referenced the U.S. Environmental Protection Agency which states that: "A screening-level risk assessment, by definition, utilizes very conservative assumptions such as worst-case dispersion modelling to estimate risk. If a screening level risk assessment does not indicate a concern, then a further, more comprehensive analysis of risk is unwarranted." CRHA also noted that there were no discussions of uncertainty in the risk assessments or of anticipated problems which could lead to a blowout. CRHA believed that Cdn 88 had not used risk assessment appropriately in addressing public safety. Specifically, it had not linked its risk assessment with its ERP. CRHA also expected societal risk analyses for SO₂ and H₂S based on discussions with Cdn 88.

Source Characterization

The Committee presented results from the SLAB model which used a much colder, denser release than Cdn 88's modelling, containing liquids in the form of an aerosol mist. The colder, denser release was determined by modelling the expansion of the release using the source parameters provided in Cdn 88's SLAB risk assessment and by allowing for the formation of condensable liquids. The Committee argued that this approach is necessary to be more representative of an uncontrolled release, in the event that it occurs.

Frequency of Uncontrolled Sour Gas Releases

Both the Committee and CRHA presented a range of frequencies to show the sensitivities of the predicted risk to this input. They both used EUB blowout data from 1975-1988 to estimate the base case chance of a blowout for a sour gas well during drilling, production and servicing. The Committee presented a computed high case based on EUB documents and a computed low case using Cdn 88's frequencies.

The Committee did not adjust these blowout probabilities to recognize the critical well factor of 0.25 as the Committee stated that "it is an arbitrary value and its use is not supported by fact." It multiplied the drilling blowout probability by a depth adjustment factor of 2.0 to account for the increased probability of taking a kick in deeper wells. CRHA thought that the depth adjustment factor was appropriate and suggested an exploratory well adjustment factor was also applicable to this well.

The Committee did not support the use of an annualization factor as it believed it is a misinterpretation of data which reduces the representation of risk. CRHA stated that the one month drilling time in the sour zone is hidden in the drilling blowout probability rate and need not be accounted for again. Similarly, CRHA made no adjustments to the annual servicing and production well release frequencies. The Committee also suggested that the time interval to ignition is pivotal to the estimation of risk. It provided risk estimates using SLAB results assuming the release is not ignited for zero, 5, 15, and 30 minutes. Immediate ignition implied no delays (zero minutes) to it. It noted that delaying ignition increases the risk near the well by a factor of about 100 for drilling and by a factor of about 1000 during servicing compared to Cdn 88's estimates. At distances further from the well, risk increases as the delay time increases.

Consequence Modelling

The Committee relied on the probit approach with the triple-shifted Rijnmond parameters to relate the toxic load of an exposure to the probability of lethality. It noted that this was the EUB approach but argued that the triple-shifted parameters represented a conservative estimate of the probability of lethality and not the probability of serious, irreversible health effects as suggested by the Advisory Committee. It believed that the approach is for lethal, not sub-lethal effects.

CRHA believed that the assessment using unshifted Rijnmond parameters had inappropriate assumptions about H₂S toxicity and supported the use of the triple-shifted Rijnmond parameters. CRHA also maintained that Cdn 88's estimate of the lethal concentration of sour gas (500 ppm) is not conservative enough because it did not recognize the hypersusceptibles, as suggested by the ATSDR 1997 toxicological profile on H₂S.

The Committee provided contours that showed predicted outdoor H₂S levels of 100 ppm extending eight km downwind using the SLAB model. In its review, the outdoor lethal zone to a probability of one per cent extended about 5.5 km. It stated that the probability of a fatality indoors could extend six km under very poor dispersion conditions. This apparent inconsistency, as noted by Cdn 88, was due to comparing results using different dispersion sets and models. In addition, the Committee presented evidence that, during a 30-minute release of sour gas, the four-km EPZ proposed by Cdn 88 would be exceeded during about 50 per cent of the dispersion conditions. In its opinion, the four-km EPZ put forward by Cdn 88 was inadequate and the zone should be increased significantly. CRHA requested the distance to the 100, 20, and one ppm H₂S isopleth and that these results be incorporated into the ERP.

The Committee submitted that channelling of an emission plume is possible and that gravity flow of dense sour gas would add to the dispersion distance. It cited two examples illustrating that emissions do travel considerable distances in major valleys trending south east or eastward into Calgary; a major grass/brush fire in the Big Spring Creek valley on 31 October 1997 which delivered heavy smoke into the north areas of Calgary, and a night time emission of sour gas and/or mercaptan from the Shell Jumping Pound gas plant, which delivered gas of unknown concentration a distance of over 30 km into Calgary via the Bow River valley on 19 December 1997.

With respect to SO₂, CRHA requested that additional SO₂ modelling be done by Cdn 88 in order to define concentrations that may occur in that Calgary area. Specifically, CRHA said that Cdn 88 had not explicitly described the SO₂ isopleths of concern nor did it provide population estimates of exposure and adverse health effects.

Risk Evaluation

It was the Committee's and CRHA's view that the risks associated with the drilling, production and servicing of the proposed well are significantly higher than the risks presented by Cdn 88. The sensitivity to the ignition delay during drilling was illustrated by the Committee and shown to increase the risk by as much as a factor of 100. Results were compared to the Major Industrial Accidents Council of Canada's Risk-based Land Use Planning Guidelines and the Committee suggested that the minimum EUB setback of 1.5 km for public facilities for a level four facility may not be adequate for this well.

7.3 Views of the Board

Purpose and Approach

The Board believes that before risk can be managed, it must be understood. Prior to making decisions and taking action, the risk management process develops options and evaluates their impact with respect to public safety. Risk assessments have several purposes:

1. To understand the nature and the extent of the risk and the factors that predominate the risk
2. To establish the extent of reasonable emergency awareness planning zones taking into consideration plume dispersion modelling for H₂S and SO₂
3. To compare the risks of this proposed development to other familiar risks
4. To address concerns of the public in the area which may be impacted by accidental releases

Cdn 88 has focussed on item 3, comparing the risk of the well to show that the risks are acceptable, and in the Board's view did not address the other issues adequately.

The Board believes that quantitative analysis should be one of a number of factors used to evaluate the risk of facilities. Considering the wide variety of factors that need to be considered, the Board also believes reasoned judgement to be a critical component of any evaluation or decision to proceed with such projects. The EUB has no prescribed method of performing risk assessments, although it has published many documents and has been involved with several public consultation committees in order to provide some guidance on the matter. There are also many other references outlining approaches to doing risk assessments. Quantitative risk analysis requires considerable computer modelling to simulate the release events. The assumptions and approach used in such models should be conservative but realistic. The uncertainties associated with the risk estimates should be discussed.

Source Characterization

An important step in analyzing the risks is defining the source conditions. Clearly, from the evidence presented, a lighter-than-air sour gas composition is not expected. Accordingly, none of the lighter-than-air sour gas mixture results submitted were considered by the Board.

Defining the release conditions at atmospheric pressure, before air is entrained is critical in estimating the dispersion and rise of the release determined by the model. This is evidenced by the long narrow plumes predicted by Cdn 88 versus the short wide plumes of the interveners using very different inputs to the SLAB model for the same release. The Board expects some liquids to be present as an aerosol at the reduced temperatures associated with expansion to atmospheric pressure. A dense gas model is therefore required. The Board believes that a reasonable conclusion would be somewhere between the diverse range of predictions by the experts of Cdn 88 and the interveners.

Frequency of Uncontrolled Sour Gas Releases

The Board concludes that there is no significant difference between the uncorrected blowout probabilities used by Cdn 88 and the interveners. The Board believes that the annualization factors used by Cdn 88 are not applicable to drilling release probabilities or servicing release frequencies. For drilling, the release probability is an event-based statistic, and since there is one drilling event per year, the annualization factor is one. Therefore, the risk estimates presented by Cdn 88 for drilling are low by a factor of 13. For servicing, the release frequency is based on the assumption that one servicing operation is made per well per year. The servicing rate is already on an annual basis, and therefore, should not be reduced by the annualization factor of 26 used by Cdn 88.

An application of the critical well factor to reduce the blowout probability is acceptable to the Board. Although no statistical evidence exists, in the Board's judgement the 0.25 critical well factor and the application of a depth correction factor is reasonable for this situation. The Board believes that the exploratory well factor is inter-related to the depth correction factor. Cdn 88 did not mention either of these factors in its risk analysis. Given the previous EUB-published work on well blowout probabilities, the Board expected discussions on why deeper exploratory wells tend to have higher blowout rates and what is being done by Cdn 88 to prevent similar cases from happening.

The Board notes that the term "immediate ignition" has been used loosely by industry and could lead to some confusion about ignition in the mind of the public. The probability of ignition cannot be accounted for until attempts have been made to ignite the release. Obviously a one minute sour gas release would have considerably less consequences than a 30-minute release. The Board believes that the risk results presented by the interveners showing the importance of reduced ignition delay time are significant. Cdn 88 committed to demonstrating that an ignition delay time of one minute to quickly evacuate the drilling crew to safety is achievable. A similar commitment will be required for servicing operations should the well be approved.

Consequence Modelling

Given the work that has been done in Alberta to date, the Board believes a probit approach with triple-shifted Rijnmond parameters is helpful in evaluating the risk from sour facilities. The Board notes the Advisory Committee specifically recommended that irreversible health effects, defined by the triple-shifted Rijnmond parameters be identified as a criteria for defining consequences from sour gas exposure. The Board believes these conservative results can then be used to estimate risk for comparison to risk acceptability guidelines. Mitigative steps can also be adopted to reduce the identified risk and to avoid unnecessary risk on the hypersusceptible population.

The Board notes that the lethal threshold of 500 ppm for H₂S presents different results to those using the triple-shifted Rijnmond parameters. The Board also notes that Cdn 88 had redone the SLAB risk assessments using a triple-shifted probit parameter approach. Although the Board observes that this approach presents a somewhat higher risk, it does not alter the conclusion that the facility can be operated safely.

Cdn 88's H₂S modelling using SLAB is of limited use to the Board because the source term is inappropriate. Given the high H₂S, carbon dioxide and heavy hydrocarbon composition of the sour gas, a fraction of the sour gas release is expected to be in the form of an aerosol once it has expanded to atmospheric pressure and before air is entrained. The SLAB model simulates the initial dense behavior as air is added and the liquids evaporate resulting in a sour gas-air mixture. The Board considers the results presented by the interveners to be more representative of a potential release than those of Cdn 88.

The concentration contours of maximum predicted ground-level SO₂ provided by Cdn 88 have purpose in verifying the size of the EPZ but they are not useful during an emergency. The Board suggests that plume isopleths for the range of dispersion conditions would be helpful to emergency measures organization. The Board expects Cdn 88 to work with all affected emergency measures organizations to assist in the preparation of such plans.

Risk Evaluation

Public safety is of paramount concern to the Board and therefore the risks of sour gas developments are taken very seriously. Cdn 88's submissions suggest that the risks associated with level 4 wells are negligible relative to other risks typically encountered in society. Recognizing adjustments discussed earlier for source term, frequencies, and probit parameters, the Board believes Cdn 88 has underestimated the risks. The Board also believes the use of over conservative parameters in risk assessments would present an unrealistically high level of risk from such facilities. The Board suggests that realistic factors which have a foundation in fact or judgement should be the norm to evaluate risk. Where the risk is found to be acceptable, but mitigative steps can be taken to reduce or minimize that risk, such steps should be taken. Using the risk estimates supplied by the interveners as an upper estimate, the Board believes by strict adherence to the risk control measures, required in the existing regulations and the extra conditions included in this decision, the actual risk to the public to be very small.

In the Board's view, the proposed well does not represent a materially higher risk than existing facilities throughout Alberta. However, with respect to acceptable levels of risk, the Board disagrees with Cdn 88's conclusion that the Advisory Committee suggested an absolute risk of 10^{-4} to be acceptable. Risks of 10^{-4} were predicted within level 4 pipeline right of ways in the Advisory Committee studies. As no one lives within 100 m of level 4 sour gas pipelines, the public is not exposed to these maximum levels. The Board notes however that the Advisory Committee concluded after extensive study and consultation that the present setbacks from all sour facilities are acceptable. The Board also notes that the risk at a setback of 100 m from a level 4 pipeline is about 10^{-5} in the Advisory Committee studies and that this is comparable to what other jurisdictions consider acceptable for low population densities. The Board does not believe it appropriate to adopt specific limits for acceptable levels of individual risk but rather considers each application on its own merits.

The Board does not agree with justifying the size of an emergency response planning zone on the basis of predicted risk. Emergency response planning is done to facilitate appropriate actions being taken for a reasonable worst-case release scenario to ensure the safety of the public. The priority in such remote events must be on the public in close proximity to the facility where the risks are the greatest. Sound contingency plans should be in place to advise those within the awareness zone who could be affected but are in little immediate danger. Companies cannot be

expected to plan for the absolute worst case imaginable event, but they must plan for events that have a reasonable chance of occurring. Mitigating factors such as igniting the release can be accounted for recognizing that there could be a modest delay in ignition.

8 EMERGENCY PREPAREDNESS

8.1 Views of Cdn 88

Cdn 88 stated that it had developed a comprehensive, draft ERP that would assure protection of the public in the very unlikely event of a well control emergency. It believed that its approach to emergency response planning would minimize the potential for people to be exposed to hazardous levels of H₂S or SO₂ by removing people from areas where a hazard may exist, or alternatively, removing the hazard of H₂S from the public by igniting the release. The ERP was in draft form so that it may be updated, revised, and improved prior to drilling. The plan would also be modified to account for unique and special circumstances as they are identified. Cdn 88 believed that it had prepared a state-of-the-art ERP, however, it would always look to improve the plan and provide incremental increases to public safety and comfort.

Cdn 88 identified a four-km EPZ and an eight-km awareness zone. Cdn 88 submitted that the purpose of the awareness zone was to provide residents within the four to eight-km area with information about the well prior to and during drilling. Canadian 88 would contact all residents within eight km prior to drilling into the sour formations and prior to well testing. Cdn 88 stated that it accepted responsibility for protection of the public both within and beyond the four-km EPZ and designed the ERP with that in mind. Cdn 88 would ensure protection of the public beyond the four-km EPZ by ensuring that no potentially hazardous H₂S or SO₂ levels reach any resident. Cdn 88 believed that public protection in the event of an emergency could best be achieved by planning to ensure no member of the public was exposed to H₂S or SO₂ levels that approach evacuation levels through ignition of the source and effective evacuation of residents who could potentially be exposed. Cdn 88 stated that according to its dispersion modelling results, SO₂ evacuation criteria would not be exceeded beyond the four-km EPZ. Cdn 88 defined the following three levels of emergency and key actions to be taken for each level:

Level 1 Emergency

The H₂S formation(s) are open to the wellbore and an abnormal drilling, completion, servicing, or testing problem has occurred that has the potential to lead to a well control problem. There is no immediate hazard to the public as there is no release of H₂S gas and the situation could be controlled by on-site personnel and equipment.

Key actions to be taken by Cdn 88 to ensure protection of the public include: notification of residents within the four-km EPZ of the event and that they may voluntarily evacuate, mobile air monitoring units located on site would be alerted, a survey of the EPZ would be performed to locate residents, transients, and company, contract and government personnel required to implement the plan would be alerted.

Level 2 Emergency

A controlled low volume flow of H₂S gas would be occurring at surface which would pose a limited hazard to the public.

Key actions to be taken by Cdn 88 to ensure protection of the public include: mandatory evacuation of people in the four-km EPZ, a survey of the EPZ to locate residents and transients, the dispatching of two mobile air monitoring units to monitor H₂S/SO₂ levels (one at the nearest downwind unevacuated area within the EPZ and one at a downwind location outside of the EPZ), establishing roadblocks, assembling ignition equipment, and mobilizing all company, contract and government personnel required to implement the plan.

Level 3 Emergency

An uncontrolled release of H₂S gas would be occurring from the well that could not be controlled immediately by on-site personnel and equipment, and the situation may pose an immediate hazard to the public.

Key actions to be taken by Cdn 88 to ensure public protection include: a survey of the EPZ to ensure all residents and transients have been evacuated, continuing H₂S/SO₂ monitoring downwind of the well and at the nearest unevacuated area, and ignition of the uncontrolled H₂S flow if the ignition criteria has been met.

Cdn 88 stated that if a level 1 emergency occurred, it would take some time for the gas to reach the surface, thereby, providing the time required to take the actions outlined to protect the public.

Cdn 88 stated that it would have two mobile air monitoring units located at the wellsite prior to drilling into the sour formations. Both units would be dispatched downwind of the well at a level 2 emergency, one inside and one beyond the four-km EPZ, and would monitor for H₂S and SO₂. Additional mobile monitoring units would be readily available if required.

Continuous fixed ambient H₂S/SO₂ monitoring systems would be situated outside of the four-km EPZ during drilling and completion operations at each of the four residential subdivisions; Hill Spring Meadows, Equestrian Estates, Willow Way, and Mistyvale Estates.

Cdn 88 stated that it would ignite the well in any of the following situations:

- if the well was experiencing a partially-controlled or an uncontrolled flow of H₂S gas at surface and public safety could not be assured because evacuation of the public within the EPZ could not be accomplished
- air monitoring data indicated H₂S levels in excess of 20 ppm for a three-minute average in unevacuated areas
- stationary air monitoring equipment located in proximate subdivisions or mobile air monitoring at any urban density development including Calgary, Airdrie, and Cochrane indicated one ppm of H₂S averaged over one hour
- air monitoring was not taking place due to some unforeseen circumstances, such as bad weather, or a communication breakdown

Cdn 88 proposed to have the following ignition equipment available to ignite any release of H₂S:

- automatic ignition system on the flare line

- automatic ignition system at the wellsite
- auxiliary automatic ignition system at the emergency control center/on-site control centre
- shotgun-type flare guns complete with 25-mm flare shells

Cdn 88 said that notification and voluntary evacuation of the public beyond the four-km EPZ would take place if H₂S levels reach one ppm (one-hour average), five ppm (one-hour average), 10 ppm (15-minute average), or 15 ppm (15-minute average). Immediate ignition would take place if H₂S levels reach 20 ppm (three-minute average). Cdn 88 would also offer voluntary evacuation following ignition if SO₂ levels reach 0.3 ppm (24-hour average), one ppm (three-hour average) or two ppm (one-hour average).

In-place sheltering may be offered instead of evacuation under very limited circumstances such as awaiting transportation during a short duration release of sour gas.

Cdn 88 stated that public protection measures beyond the four-km EPZ would be co-ordinated by the MD according to pre-established procedures.

Cdn 88 indicated that it proposed to use a computerized telephone call out system as its primary means of notifying the public within the EPZ in the event of an emergency. The system would be capable of delivering a variety of messages depending on the nature of the emergency. The system would verify that the call had been received and would provide the telephoners with information regarding follow-up required. Telephoners would then contact residents within the EPZ with priority given to those requiring assistance. Evacuation personnel would also physically search the area and confirm that evacuation has taken place.

Cdn 88 stated a four-km EPZ is consistent with industry standards established in the CPA/IPAC Guidelines for Preparation of Emergency Response Plans and that the four-km zone could effectively be managed. In addition to this guideline, Cdn 88 stated that it also based its decision to use a four-km EPZ on plume dispersion modelling which indicated that there would be no need to evacuate beyond four-km if the release was ignited because SO₂ levels would not reach evacuation levels. Cdn 88 believed that ignition would be possible within one minute. In addition, Cdn 88 stated that it would also be in a position to co-operate with and assist the MD and other support services with any necessary actions to protect the public beyond four-km.

Cdn 88 stated that it had applied to the EUB to use a four-km EPZ and approval was granted. It said that it was not aware of any instance where a zone larger than four-km had been used. Additionally, Cdn 88 stated that witnesses appearing on behalf of intervenor groups and representatives of the MD endorsed the draft ERP, including the use of a four-km EPZ. Cdn 88 contended that although several intervenors had criticized the use of a four-km EPZ, they had not been able to support the purpose or the benefit of using a larger EPZ.

Given that it would be possible to ignite the well quickly, Cdn 88 believed that extending the size of the EPZ beyond four-km for evacuation would potentially and unnecessarily expose additional members of the public to additional risk.

With regards to ignition, Cdn 88 stated that it would immediately ignite any uncontrolled flow of sour gas to ensure protection of the public. It noted that immediate ignition had been previously accepted by the Board as a reliable response to an uncontrolled flow in areas such as East Calgary. The ignition criteria Cdn 88 proposed to use would be nearly identical to those established and accepted for the Northeast Calgary facilities by the Northeast Calgary Application Consultation Committee in its report dated June 1992. In Cdn 88's view, the only remaining issue with respect to ignition would be the time it might take to ignite a release.

Cdn 88 stated that the hazard from the well is modeled assuming the worst case flow conditions and that it would take some time before a release could physically reach this level. Emergency planning experts acting for intervener groups acknowledged this.

Cdn 88 stated that it was confident that procedures outlined in its ERP were sufficient to ensure that ignition could take place within one minute of a maximum flow of gas from the well. Cdn 88 would ensure that its rig crew was trained so that this objective would be met. It would also require its crews to demonstrate through drills that they were able to ignite the well under various scenarios within one minute. Cdn 88 stated that if the Board believes that it is appropriate, it may wish to condition the well licence to require Cdn 88 to demonstrate this to the Board's satisfaction prior to allowing Cdn 88 to drill into the sour zones.

Cdn 88 stated that if there was a release of sour gas from the well, the mixture of methane and H₂S would ignite and burn. The expected mixture is a more flammable substance than methane alone. It further stated that it is not aware of any circumstance which could occur where any substantial flow of methane and H₂S could not be ignited and burned. Ignition of a release would convert any H₂S to SO₂, resulting in a dramatically less significant hazard. Dispersion Modelling for SO₂ indicated that evacuation levels would not be exceeded beyond the four-km EPZ even under worst-case weather conditions. Cdn 88 noted that if there were any effects of SO₂ to the public, they would be nothing more serious than discomfort, even to hypersusceptibles. Cdn 88 contended that there would be sufficient time to evacuate any SO₂ hazard area as hazards associated with SO₂ are measured in hours and days and not minutes. The opportunity would exist to evacuate people to more comfortable surroundings if required.

Cdn 88 confirmed that the decision to ignite a release at the well would be made prior to drilling into the sour zone and would be based on its pre-defined ignition criteria. The authority to ignite would also be designated prior to drilling into the sour zone. Gas must first enter the wellbore from the formation, referred to as a kick, and work its way up the wellbore to the surface before a release could occur. Once a kick was detected, Cdn 88 would immediately ignite a propane pilot at the end of the flare system to burn any gas that may come to surface. In the event of such a minor release, the volume of gas being burned at the flare would be several magnitudes less than in the event of an uncontrolled flow.

Cdn 88 stated that it was not aware of any scenario where there would not be prior warning before an uncontrolled release. Once ignition criteria had been met, it would be mandatory for the responsible party to ignite the release and no debate on the issue would take place at that time.

Cdn 88 stated that it has had a number of meetings with local disaster services representatives of the MD. It said that the parties are in the process of developing a written agreement, a draft of which was provided to participants, detailing the support the MD could provide to Cdn 88 in the

unlikely event of an emergency. Although Cdn 88 accepted that it would be responsible for any emergency response required as a result of an incident at its well, the MD has agreed to assume the lead role in co-ordination of local disaster services and emergency support required beyond the four-km EPZ. The MD supported the agreement in principle, however, details were still being finalized. Cdn 88 indicated that it would provide a copy of the signed agreement to the Board once it was finalized. Additionally, Cdn 88 stated that it had several meetings with the Cities of Calgary and Airdrie and with the Town of Cochrane to discuss mutual aid agreements in place between these parties and the MD. Cdn 88 discussed the local ERPs that are in place as well as the Provincial Government Emergency Response Support Plan with local disaster services representatives and as a result had made several enhancements to its site specific ERP.

Cdn 88 also indicated that it would carry out ERP exercises prior to drilling into the sour zones to test the capability of responders to implement procedures as described in the plan and to ensure coordination of activities with local and provincial ERPs. It stated that public safety is of paramount importance and testing procedures outlined in the ERP and coordination with other plans is essential and is also a requirement of the EUB.

8.2 Views of the Interveners

The Turners stated that they had reviewed the risk and safety information submitted by Cdn 88 and were confident that exploration and development could be done safely. They further stated that no amount of money would be worth risking the health and welfare of their family or their neighbours.

The intervener groups expressed many concerns regarding Cdn 88's proposed ERP, the use of a four-km EPZ, and the ability of Cdn 88 to respond to an emergency.

The Committee submitted that the four-km EPZ was not adequate and the reduction from 18-km was unwarranted. The Committee contended that Cdn 88 had shown no desire to accept responsibility for health and safety of the public beyond the four-km EPZ, other than to notify residents within the eight-km awareness zone. The Committee questioned whether Cdn 88 had the financial capability to cover evacuation, damage and possible litigation costs resulting from an emergency beyond the four-km zone. The Committee believed that the drilling of the proposed well adjacent to large population centers could potentially overtax the resources of the MD and the City of Calgary. Evacuation of a large population would be ineffective particularly during poor weather conditions.

The Committee was opposed to the application, however, it suggested that in the event the application was denied and Cdn 88 reapplied, the Committee would recommend that the size of an EPZ be based on dispersion modelling so that it was sufficient to protect local residents.

Several members of the Committee did not believe that the ERP adequately addressed site specific needs of their families in the event of an emergency. The Committee questioned whether Cdn 88 had agreements in place with other responders as outlined in the ERP and whether the necessary resources would be available in an emergency situation.

The Committee carried out a survey of residents within the EPZ and compared the results to information gathered by Cdn 88. It concluded that Cdn 88's information was incomplete and inaccurate which in the Committee's view prompted Cdn 88 to re-survey residents in the area.

The Coalition believed that it was the responsibility of Cdn 88 to demonstrate a corporate commitment and ability to address outcomes and risks from its facilities. Carefully planned actions must be defined in an ERP and industry must demonstrate that it has sufficient resources and the capability to implement its ERP. It believed that the potentially-affected public must be provided with the opportunity to have input into an ERP. The Coalition did not believe that Cdn 88 had fulfilled these responsibilities. The Coalition stated that Cdn 88 had not submitted any documentation to support the use of a four-km EPZ and had not provided information to indicate that a larger zone would be unmanageable. The Coalition was of the view that a significant burden would be placed on municipal emergency responders who, according to Cdn 88's ERP, would be responsible for emergency procedures beyond the four-km EPZ.

On the basis of information provided in Cdn 88's resident information packages, some members of the Coalition believed that the ERP was inadequate and incomplete. Specifically, they believed that it did not adequately address emergency response during extreme weather conditions, facilities for medical aid to those affected by a release, the capability of Cdn 88 to respond, including the availability of sufficient numbers of trained personnel, and training of the public in the use of emergency equipment such as self-contained breathing apparatus.

Emergency response planning experts acting for the Coalition concluded that the draft ERP submitted by Cdn 88 met or exceeded EUB requirements and industry standards. The representatives confirmed that the use of a four-km EPZ was consistent with normal industry practice for wells with a potentially high H₂S release rate. They further stated that Cdn 88 had incorporated other procedures, such as immediate ignition, in its ERP to address public safety beyond the four-km EPZ. However, the ERP experts for the Coalition made the following recommendations for improvement of the plan, although they did not consider these points to be of major concern:

- update resident information prior to drilling into sour zones
- test radio communications to ensure there are no dead spots
- determine the need for available evacuation vehicles while drilling the sour zones
- notify residents within the four-km EPZ prior to testing
- verify map information
- conduct an emergency plan drill for the purpose of training staff and testing proposed procedures

CRHA stated that Cdn 88's ERP should be tailored to this specific well and should include specifics regarding events which could cause the ERP to be activated. CRHA believed that Cdn 88 had not linked its risk assessment with the ERP, and therefore had not adequately addressed the safety of drilling the proposed well in close proximity to an urban population. In its view, a well designed ERP should consider the potential size of the affected population, including adverse health consequences, not only lethality. In CRHA's view, using a four-km EPZ would cause Cdn 88 to be under-prepared to deal with potential consequences to the community from an actual release of H₂S. CRHA believed that Cdn 88 had not explicitly delineated a process for responding to an emergency in densely populated communities such as Calgary and Cochrane and that its ERP had not been adequately co-ordinated with local

municipal governments. CRHA considered it unacceptable that responsibility for protection of the public beyond the four-km had been delegated to the MD. CRHA indicated that it had requested information from Cdn 88 regarding its intent to exercise its ERP but received no response. This suggested to CRHA that Cdn 88 had not recognized its responsibility to ensure that its ERP was practical. Additionally, CRHA stated that Cdn 88 had not provided any data to suggest that it was capable of implementing procedures as outlined in the draft ERP.

CRHA recommended that if Cdn 88 used ignition of a sour gas release as a mitigative measure, it must also evaluate the risk to the public of exposure to SO₂. It must also develop emergency response procedures to protect the public from exposure to SO₂ based on provincial and federal criteria. CRHA was concerned that it may be overwhelmed with concerns from the public within Calgary in the event of an emergency at the well. CRHA also requested that Cdn 88 clarify how it would propose to evacuate special facilities such as the Spyhill Correctional Facility within Calgary.

The MD stated that the Municipal Fire Chief (Director of Disaster Services) had reviewed the draft ERP and was of the opinion that it was detailed, comprehensive, and adequate to protect the public, although some details needed to be finalized. The MD believed that Cdn 88 had adequate personnel and equipment available to respond to an emergency within the four-km EPZ.

The MD stated that it was prepared to take on the responsibility for emergency response beyond the four-km zone. The MD had an emergency response plan in place and was responsible for any potential emergency within its boundaries. The MD stated that it had many emergency support services available to it within the MD and that mutual aid agreements are in place with the surrounding cities, towns, and other municipalities for the purpose of providing additional assistance. The MD indicated that if Cdn 88 successfully obtains a well licence, it would work co-operatively with Cdn 88 to ensure all details are finalized prior to drilling.

The Lockes stated that animal evacuation would not be feasible in the event of an emergency. The Lockes believed that due to the location of their residence and the condition of roads in the area, evacuation would be difficult or impossible particularly during adverse weather conditions.

The Lockes stated that the MD, not Cdn 88, should have a primary role in the emergency response within the four-km EPZ. They also expressed concern with the ability to contact residents in the event of an emergency because many people may be in the field far from their homes. They stated that, in their view, it would be very difficult to practically evacuate the EPZ. The Lockes also expressed concerns with the adequacy of the four-km EPZ and with the effective use of cellular phones in the area.

Mr. Goodhart said that the emergency response required could exceed the capability of the responders. In his view, because of the consequences of an emergency in terms of injury, death and economic loss, the well should not be approved.

Mr. Goodhart stated that Cdn 88 had not identified medical personnel competent to handle patients exposed to H₂S. He suggested that Cdn 88 should ensure that sufficient doctors and support staff are trained and available for detoxification of people with H₂S poisoning if the well is approved.

Mr. Goodhart acknowledged that Cdn 88 was prepared to include his residence in the ERP even though he lives beyond the four-km EPZ. He stated that he will fully co-operate with Cdn 88.

However, he also indicated he would have no choice but to move from the area if the well goes ahead because of his particular sensitivities.

8.3 Views of the Board

The Board is satisfied that Cdn 88 has developed a comprehensive ERP that meets EUB general requirements, although some enhancements are necessary due to site specific circumstances as discussed in this section. The Board requires operators to develop site specific ERPs for the drilling of sour gas wells. Each plan must identify the size of the EPZ being used and must address site specific measures to be taken to protect the public in the event of an emergency. Although the operator's plan is expected to focus on actions to protect the public within the EPZ, it must also address how the plan will be coordinated with municipal and provincial plans for assistance and protection of the public beyond the EPZ. Board policy provides applicants with the opportunity to apply to use a reduced EPZ, where the calculated EPZ would be considered unmanageable in the early stages of an emergency. The criteria used to determine whether a reduced EPZ is appropriate includes a review of the size of the calculated EPZ, local terrain, population density, evacuation, ignition and sheltering criteria, and air quality monitoring strategy. Several components of the ERP would usually require enhancement if a reduced EPZ is approved.

The Board notes that Cdn 88 has proposed to use a four-km EPZ with an additional awareness zone to eight-km. The purpose of the awareness zone would be for notification only to residents of drilling and testing operations and no further emergency response measures have been defined. As it is important that the operator and the public understand the possible extent of the hazard area, the Board will require that Cdn 88 work with parties within the EPZ to assure it is complete and that the public has an opportunity for input, to understand the content and to appreciate the nature of the follow up. The Board notes that Cdn 88 has addressed public safety beyond the four-km EPZ in the draft ERP by way of the stringent ignition criteria and co-ordination of the plan with the MD. However, in this particular case, the Board believes that Cdn 88 should identify sensitive individuals within the eight-km awareness zone. The ERP should outline procedures to notify those designated as sensitive at a level 2 emergency and provide the option to evacuate and to evacuate all those who are sensitive if the well is ignited. These measures would provide sensitive individuals protection from any exposure to SO₂. Although the draft ERP does include SO₂ evacuation criteria, based on provincial criteria no procedures have been defined.

A common safety measure for a sour gas release is to ignite the gas. Igniting the well would convert the H₂S in the gas to SO₂ which would be more widely dispersed due to thermal rise and limit the public risk. The Board recognises that there is concern over the extent of the area which may be impacted by SO₂. However, it is the Board's judgement that SO₂ levels would not likely reach provincial evacuation levels and that procedures, including those noted above would be in place to assist those who may experience discomfort. Given the circumstance, the Board believes that any uncontrolled flow of sour gas should be ignited immediately to provide assurances that prompt action is taken and impacts are minimized. The Board expects the ERP to be modified to reflect this condition and to reflect the management protocol to implement the necessary actions.

The Board is confident that immediate ignition of a release is possible if the crew responsible is adequately trained, and that, once the well is ignited, it would remain burning due to the mixture of methane and H₂S. The Board notes that Cdn 88 has proposed redundant ignition equipment, including an automatic ignition system at the well site, an auxiliary automatic ignition system at the emergency control centre and a flare gun. While the Board is satisfied that the basic evacuation criteria proposed by Cdn 88 should be acceptable, it will require it to be tested to assure all individuals required to implement the evacuation are sufficiently familiar with the details. According to the draft plan, evacuation of the public within the EPZ would begin at a level 1 emergency and would be completed at a level 2 emergency before there is any risk of exposure to H₂S. The Board would expect Cdn 88 to identify and include in its ERP procedures to address special evacuation needs of the public.

With respect to evacuation of animals, protection of the public is of primary importance and should remain the focus of a site-specific ERP. Evacuation of animals may be possible at the early stages of a well control problem before a release occurs but only if it is safe to do so.

The Board considers Cdn 88's proposal to use the computerized telephone call out system to deliver emergency messages to be acceptable. It notes that the computerized messages would be followed up with telephone contact and a physical search of the area to ensure evacuation has taken place. The system should be in place and tested before the well is spudded to assure it performs as expected. With respect to ambient air quality monitoring, the Board believes that two mobile monitoring units stationed at the well site during drilling in the sour zones and the four stationary monitors located at sub-divisions beyond the 4-km zone would be adequate to detect and monitor H₂S and SO₂ levels in the event of an emergency.

The Board notes that effective emergency response protocols rely on the public to be knowledgeable about the event and to respond in an informed way to the measures taken. To do so, the ERP should be developed with assistance of the public and address reasonable concerns raised by them.

The Board believes that it is Cdn 88's responsibility to ensure that an adequate ERP is developed and in place to protect the public in the event of a well control emergency. The Board recognizes that such a plan would include responsibilities of other parties to work with the company personnel in responding. It is acceptable to and expected by the Board that the operator coordinates its plan with municipal and government plans. Local and provincial authorities also share responsibility for protection of the public and should have complementary plans in place to provide assistance. In this case, the MD has agreed to assume responsibility for emergency response measures beyond four-km, although this agreement has not been finalized and does not eliminate Cdn 88's responsibility to provide assistance. The Board will need to be satisfied that adequate municipal and provincial resources would be available to assist the MD. The Board notes that the MD has acknowledged responsibility for protection of the public within its area of jurisdiction and must be prepared to respond regardless of the type of emergency. The Board expects the written agreement between Cdn 88 and the MD to be finalized and submitted to the Board prior to drilling if a licence is issued. The Board notes the concerns raised by the City and some agencies that large scale evacuation may be necessary in Calgary. Given the available information such actions are both unreasonable and unlikely.

The Board expects Cdn 88 to review details of the plan and update all information including resident information, mapping, emergency contacts, and resources and submit the final plan to the Board for review and approval prior to drilling if a licence is issued.

The Board **also** believes that it would be necessary to test all procedures detailed in the ERP prior to drilling to ensure that response personnel are adequately trained and capable of carrying out responsibilities. The Board notes that no evidence was presented to suggest that Cdn 88 would not be capable of responding to an emergency, however, this is difficult to assess without testing the ERP. The Board expects Cdn 88 to test all key components of its ERP, including the chain of command, computerized telephone call out system, communications equipment, communications linkages including outside services, evacuation procedures, and ignition procedures and to satisfy the Board that the systems are in order for immediate implementation.

The Board expects Cdn 88 to implement a system of safety briefings for all individuals in the drilling operation to assure full knowledge of the ERP and the actions to be taken, in particular to matters relating to the ignition criteria.

9 LAND USE IMPACTS

9.1 Views of Cdn 88

Cdn 88 provided the Lochend Conceptual Development Plan to discuss well site facilities, gas processing plants and potential pipeline corridors that may be required if the proposed wells were successful. The exploratory well will test a seismically-defined Swan Hills reef prospect with an upside potential reserve base as high as $28 \times 10^9 \text{ m}^3$ of gas. Gas composition, production rates and number of wells to deplete the reservoir are uncertain. The Caroline Field is a similar structure and has 15 wells. The well site facilities will depend on the gas analysis and the processing facility to which the gas is sent. Cdn 88 identified five existing, nearby processing facilities (Petro-Canada Wildcat Hills, Can-Oxy Crossfield East, Amoco Crossfield, Cdn 88 Olds, and Shell Jumping Pound) along with potential pipeline corridors from the Lochend area to each processing facility. Cdn 88 also provided the spare capacities of these plants to handle gas volumes and sulphur processing. The pipeline corridors parallel existing rights of way where possible. Potential pipeline routes had a 1.5-km setback to urban centres or a public facility for a level 3 pipeline, except sections that would require a level 2 pipeline (500 m setback) because of existing developments.

Cdn 88 noted that this application is for this exploratory well only and understood that future developments would require separate applications.

9.2 Views of the Interveners

The City maintained that the prospect of a major new sour gas field being established northwest of Calgary raised a number of issues for the City. It said that although the proposed well, in and of itself, is not likely to negatively impact Calgary's growth, it took little comfort from the conceptual development plan as it lacked details and commitments. Should the gas be taken to the Can-Oxy Crossfield East, there could be implications to Calgary. The City stated that: "Approval of this initial well, outside the context of a more comprehensive plan for the development of the field, is not in the public interest, taking into account the already developed

nature of the area, its proximity to Calgary in terms of future long-term growth options and the need to coordinate land use planning for surface development with the planning for resource development.”

The City believed that it was necessary for Cdn 88 to demonstrate that the full development is capable of being satisfactorily operated. It suggested that there would be merit in approaching the development plan similar to the Northeast Calgary public consultation process experience. Through that process, an overall plan for the development of the sour gas resources, including future wells and pipelines, was developed in close consultation with affected residents, municipal authorities, public safety officials, and the EUB.

Mr. MacFarlane, the Counsellor for the division within the MD in which the well is proposed, was opposed to the drilling of the well. He stated that this location is very near to lands considered by an area structure plan for continued subdivision and residential growth, and was therefore opposed to the well.

The MD quoted following its goals: “The Municipality shall encourage the planning and development initiatives in the Municipality and shall take into account the need to utilize natural resources,” and “The Municipality shall facilitate human settlement patterns as need for that settlement occurs, but shall take in to account the paramount need to preserve agricultural lands.” It noted that the area around the proposed well site is predominantly zoned for agricultural uses. Resource extraction activities, while governed by the Board, are consistent with the preservation and continuation of agricultural activities. Also, there are no residences or developments that infringe on the Board setback requirements for a level 4 sour-gas facility. The Municipality said that it was not opposed to Cdn 88’s application, but requested that the sour gas well development be completed in a manner that does not compromise the health and safety of residents.

The MD stated that in terms of country-residential development, this is one of the more intensely developed areas in the MD. The Bearspaw Area Structure Plan identified the area south of the boundary of the four-km EPZ as an area in the municipality for more intensified residential development. However, within the proposed four-km EPZ, there have been no additional plans for development approved.

9.3 Views of the Board

The Board recognizes the exploratory nature of the proposed well and agrees that only a conceptual development plan is possible at this stage. The Board considers the plan to be adequate at this time. The Board further recognizes the difficulty in providing details with any degree of certainty. In the Board’s view it is premature to determine the optimum development plan. The Board notes that all of the five existing, nearby processing facilities have the potential required spare gas capacity, but that only one has the spare sulphur capacity.

The proposed well is consistent with current land use zoning. Continued country-residential development will make it increasingly more difficult to locate facilities and pipelines in the future, so it is reasonable to determine the potential of the reserves now. Should the well be drilled and found to be commercial, the Board expects future developments to take into account the conflicting priority of resource recovery and residential growth.

As noted by Cdn 88, future developments will require separate applications and the Board will

deal with them at that time. If this well proceeds and is successful, the information will allow the proponent to refine the definition of the resources. At that time a detailed development plan will need to be developed in consultation with the stakeholders, before additional wells or facilities may be considered by the Board.

10 PUBLIC CONSULTATION

10.1 Views of Cdn 88

Cdn 88 indicated that it conducted personal consultation and notification with respect to the proposed well in April-May 1997 by providing an information package to all land owners within the four-km EPZ about the well characteristics, the well location, and the ERP. It provided a description of the ERP including information about evacuation procedures and evacuation centres. Company representatives responsible for the well, and their telephone numbers and telephone numbers for the EUB representatives were also included. The information package noted that Cdn 88 needed landowner assistance to prepare the ERP, and details of what was needed to compile contact information. At the same time, Cdn 88 said it needed to talk to the landowners about their health sensitivities, and that it required their cooperation in preparing the plan.

In addition to the information packages, Cdn 88 submitted that it commenced a door-to-door consultation with people. If they were home, Cdn 88 would talk to them and consult with them about the ERP, the well, and about the hazards of H₂S and SO₂. It indicated that this information would be used in compiling its ERP.

Cdn 88 indicated that it tried to identify the most effective public consultation methods given the specific circumstances and given the level of emotion associated with this particular application. It was Cdn 88's judgement that the most effective way to provide people with an opportunity that was open continuously was for the public to contact Cdn 88 and meet with them, or implement other forums that landowners might propose. However, Cdn 88 believed that a public-at-large open forum would not be an effective way to communicate in this circumstance because Cdn 88 believed that it would not be able to effectively address and resolve issues.

Cdn 88 stated that although it believed that it had done everything it could to effectively work with the public, it recognized that its consultation exercise was not successful and explained why the application culminated in a public hearing. Cdn 88 believed that constructive dialogue is a two-way street. However, some residents did not want to proceed with consultation but preferred that the application be dealt with at a hearing. Cdn 88 believed that the concept of public consultation is a good one, and the guidelines that encourage and promote such approaches are well recognized and desirable. Notwithstanding, it also believed that sometimes differences simply do not get resolved. Given that the public consultation program had failed to resolve all issues, Cdn 88 believed that under the circumstances, it was necessary to move to the second stage, that of a public hearing, where the public would have an opportunity to make whatever representations they wanted with respect to the decision.

10.2 Views of the Interveners

Prize indicated that it had difficulty accepting some interveners' positions that they had not been given the opportunity to fully participate and learn about the proposal. Prize believed that all of those issues had been canvassed at the hearing. Prize noted that the participants had heard the technical aspects of the application and had the opportunity to have their questions asked and answered. However, even after that opportunity, the interveners were still not satisfied. Therefore, Prize believed that if the interveners were not accepting the evidence of their own experts, let alone the testimony of Cdn 88, there was nothing left to be done in a public consultation process.

Prize agreed with Cdn 88 that it became apparent during the discussions with the community that there were some people who were not prepared to engage in a consultative process and wanted the matter to go to a hearing. Prize believed despite its persistence to engage the people, Cdn 88 was unable to make any progress, and an EUB hearing would be necessary to determine whether the well should proceed, and that Cdn 88 elected to request that a hearing be held.

The Families Group noted that although the Committee believed that Cdn 88 ought to have provided more information sooner, the Committee's position appeared to be that it would not have made any difference to discuss the merits of the application during the consultation process. In their view, the Committee would still have opposed the well just as it opposed it at the hearing, even after everything had been brought forward for scrutiny in the Board's process.

The Turners indicated that from their perspective, there was no difficulty with respect to the amount or nature of the communication between them and Cdn 88. The Turners maintained that the position of the Committee and the Coalition were similar in that they agreed early in the process that no further attempts at consultation and communication by Cdn 88 would influence their opinion. The Turners believed that a willingness to discuss and become more informed implies an openness of mind with respect to the proposed well. The Turners believed that the vast majority of interveners simply took the position that the well should not proceed.

The Committee stated that it was not asking for an additional consultation process. At this point, it believed that the consultation process was over. However, the Committee was convinced now, as a result of that process, that fears about the integrity of Cdn 88, which arose very early on in this process, have only been reinforced by the conduct of the company that it had observed leading up to, and during, this hearing.

The Committee stated that Cdn 88 made no mention at the outset of its communication plan that the proposed well was sour gas and that it was at the very top end of critical level 4 sour gas wells in Alberta. The materials prepared and circulated by Cdn 88 made no obvious mention of the dangers inherent in this well, particularly since the well was a critical level 4 sour gas well. The Committee indicated that what Cdn 88 told the residents was that the project was already going ahead and drilling would commence on 1 June 1997. Furthermore, Cdn 88 advised the landowners in writing, in person, and by telephone not to worry because this well was no different than any other well in the Calgary area.

The Committee believed that the method of public consultation conducted by Cdn 88 led a good number of people into a false sense of security. Some thought it was an oil well while others thought it was an innocuous gas well, not a level 4 critical sour gas well in a country-residential neighborhood, at the top of a valley leading past thousands of homes, and one which could potentially affect Calgary. The Committee indicated that during early efforts made to obtain additional information about the well, both directly from Cdn 88 and from records available in the public domain, Cdn 88 staff told them to call the president of Cdn 88 for details, which calls were not returned. In many instances, Cdn 88 had to be compelled to disclose information, and had chosen not to file all of its data with the Board or to disclose to the Committee's retained experts the nature of the analyses supporting this application. The Committee stated that the effort to understand the details of this application, the technical basis and the exact nature of the risks involved had been a frustrating, painstaking, and time-consuming process. Furthermore, the Committee noted that Cdn 88's own expert witness acknowledged that it would have been desirable to have the risk assessment available during the public consultation process. Reports and information were poorly disclosed and leaked out on a piece-meal basis. Only after being demanded or compelled to be produced, by the Board, were they formally released. Once released, the information was revised repeatedly, both in form and in substance. Criteria was applied in what the Committee believed to be a deliberately erratic and inconsistent manner, the end result of which led the Committee to believe that Cdn 88's apparent strategy had perhaps quadrupled the amount of time and effort necessary to address the issues in the hearing. The Committee believed that this left them with a constantly moving target.

The Committee also observed that in early meetings with the community, Cdn 88 represented the well as a "single well pinnacle reef." After representations were made to the Board, Cdn 88 prepared a conceptual development plan showing the potential of this project likely to form a larger reservoir. The Committee believed that the company misrepresented the scope of the project.

The Coalition maintained that Cdn 88 should be clearly accountable for its failure to meet the expectations for public communications and consultation that the Board identified in its public involvement guidelines. In its view, Cdn 88 did not take the time to develop a communication and public consultation plan. The Coalition was willing to work with the company and to consider withdrawing its application in order to initiate effective consultation. This was never done.

The Coalition noted that consistent with those guidelines industry should explore every avenue of problem-solving available to it before bringing the unresolved concerns of citizens to an EUB public hearing. Those sections of an application dealing with the community, social costs and benefits, the environment, human and animal health, and emergency preparedness should be framed at an easily understood language level. When preparing for a Board public hearing, the company should place considerable emphasis on communicating information directly related to the concerns of people and how those concerns will be addressed. Additionally, the Coalition believed that as the Board indicated in its guidelines: "those Albertans who are, or who perceive themselves to be, directly and negatively affected by energy developments must have their concerns fully identified and sensitively addressed."

The Coalition believed that these guidelines are common sense, distilled out of years of experience in the evolution and resolution of energy-related disputes in this province. It also noted when it came to public involvement, while the public has important rights, it also has

certain obligations. The guidelines emphasized this where they pointed out that there are a number of things that directly-affected residents can do when they have concerns about specific projects in order to make the application process more productive and less confrontational. It believed that this included attending public meetings and requesting small group or one-on-one meetings with government and industry, to bring concerns forward to the company involved or to the Board as early as possible, and attempting to resolve as many issues as possible prior to a public hearing.

The Coalition indicated that despite repeated requests to Cdn 88 for more information and asking to meet with its members, its requests were provocatively rebuffed. It was told that Cdn 88 was doing what it had to do, and that the Coalition members could do what they had to do. Members of the Coalition went to the one open house on 8 May 1997 in search of answers to their questions, only to hear at the hearing that they were viewed by Cdn 88 as having closed, as opposed to open, inquiring minds.

The Coalition believed that Cdn 88's public consultation program was essentially a notification rather than a consultation program. It was based on a concept of risk communications that assumed that only Cdn 88 had accurate scientific data and valuable expertise, while the non-technical public had only uninformed perceptions. The Coalition submitted that, given that Cdn 88 did not take the initiative to communicate properly and adequately with the affected landowners until after it was directed by the Board in January 1998, the Coalition believed it had no alternative but to request denial of the application.

The City was also concerned that Cdn 88 had not met reasonable expectations in terms of conducting a meaningful public consultation program. It stated that important information, such as a risk assessment for the well, was not made available to the public until the actual hearing, as originally scheduled. The City noted that Cdn 88's own consultants agreed that it is desirable that this type of information be made available to and be discussed with the public as part of a consultative process. Information presented to the Board by other interveners and drawn out in examination also suggested to the City that Cdn 88's public involvement program left much to be desired in terms of the company's willingness to respond to important questions raised by affected residents. The City concluded that this is a real concern to the City, given its involvement in and commitment to, two comprehensive consultation processes: by the North East Calgary Applications Consultation Committee and the Advisory Committee to the ERCB Reviewing Public Safety and Sour Gas.

The Lockes indicated that they believed that they had been deliberately and seriously misled by Cdn 88 in their first contact with the company. They indicated that when they asked if this well would be just like the other oil wells in the area, Cdn 88 indicated it was no different than other wells in the area despite evidence to the contrary. At that point, they believed that Cdn 88 had a golden opportunity to convince them of what forthright and honest people they were. The Lockes said that Cdn 88 could have stressed at that point that its proposal was quite different from the existing oil wells, but it did not. The Lockes stated that as a result, Cdn 88 lost a significant opportunity to gain their trust.

The Lockes believed the onus should be on Cdn 88 to show them that this was an appropriate proposal. However, the Lockes believed that they had been dealt with by a company whose approach to communication and consultation did not include listening to the area residents' concerns and questions.

The Lockes said that during the hearing all that they heard was Cdn 88 stating that it had not made any mistakes concerning its public consultation process. The Lockes indicated that Cdn 88 regarded any questions from the landowners as being inflammatory and negative, all of which meant mistakes had been made by the landowners and not Cdn 88.

10.3 Views of the Board

The Board accepts that Cdn 88 provided information packages containing information about the well characteristics, its proposed location, and about the ERP. The Board notes that Cdn 88 attempted a door-to-door consultation program and held a public meeting to provide further information to the public. The Board believes that these types of public notification and consultation processes are necessary. However, the Board believes that proponents must recognize and evaluate the nature of a proposal, and the vast complexities and public unknowns associated with it in carrying out a satisfactory consultation program.

The Board notes the concerns of the interveners who, in most cases, believed that the information provided was misleading, difficult to understand, and left them with uninformed perceptions. The Board further notes that the interveners' attempts to obtain additional information to understand the details of the application, the technical basis and exact nature of the risks involved, proved to be frustrating, painstaking, and time consuming. The interveners indicated that when information was provided, it was piece-meal, revised repeatedly, and a constant moving target. The Board believes that proponents should be proactive in their attempts to assist the public to understand a project, especially when the public has assembled a willingness to work with a proponent. The Board believes Cdn 88 would have greatly assisted the interveners and the Board by providing information in a more consistent, accurate and timely fashion, that would have helped the process to be more efficient leading up to the hearing.

The Board notes that the actions taken by Cdn 88 appear to have compromised the integrity of the company in the mind of the public. It left the interveners with little sense of security, and prompted a lack of trust. The Board notes that as a result, many of the interveners did not believe Cdn 88 would be a responsible operator able to ensure that the public safety issues could be met.

The Board accepts Cdn 88's stand that communication is a two-way street. The Board notes that in many cases during Cdn 88's notification and consultation process that there may have been an unwillingness by the public to participate in meaningful dialogue. However, the Board believes that the perception by the interveners of Cdn 88's unwillingness to understand the many different consultation needs of the public led to a polarization. The Board believes proponents need to be aware of these needs and be sympathetic in attempting to understand these needs.

The Board believes that appropriate notification and public consultation must be conducted well in advance of the submission of an application to the Board. It must be thorough enough to allow all parties who are or may be affected to be sufficiently aware of not only the proposed project, but the Board process as well. The Board believes that the public must have sufficient

information to participate meaningfully in the decision-making process, to voice their concerns, have their concerns heard and properly addressed, and if possible, resolved. The proponent's information must be extensive, consistent, factual and disclosed in a timely way, and if the proposal is part of a larger project, the proponent should be prepared to discuss the entire project and to explain how its components complement other energy development plans in the area. Cdn 88 did not meet this level of public notification and consultation. The consequence was misapprehension of the risks, inflamed relationships, and an unnecessary anxiety. Given the conduct, the Board can only conclude that Cdn 88 is unable or unwilling to embrace the spirit of public consultation expected from operators in Alberta. In the Board's view Cdn 88 needs to expend considerable effort to rebuild the trust with the community or turn over the operation to others who have that trust.

11 DECISION

The Board believes that the public safety risks associated with the proposed well are representative of normal industrial risks accepted by society and that the well can be drilled safely. Additionally, the Board believes that these risks are similar to existing facilities and are acceptable if managed through strict adherence to the risk control measures required in the existing regulations. However, the Board is not satisfied that the public within the EPZ and associated awareness zone understand the ERP and how it would be executed. Very few individuals have seen and or have participated in an ERP exercise to understand its implementation, which the Board believes lead to the perceived risks by the public.

The Board is also concerned with the state of readiness of Cdn 88 to involve the county and others in implementing its ERP. The Board believes that Cdn 88 should carefully design and implement a process that would allow members of the public who are prepared to participate in completing the ERP do so in a meaningful way.

Given the above, and having considered all of the evidence, the Board is prepared to issue the well licence after Cdn 88 has undertaken, committed to, and submitted the following for Board review:

1. Cdn 88 shall develop documented management processes, including policies and procedures for equipment design, specification, procurement, construction, and operations for drilling, completing and testing the well. An assessment of the effectiveness of the management processes shall be audited and endorsed by a suitably qualified third party before submission to the EUB.
2. Cdn 88 shall satisfy the Board that the equipment and procedures to be used by the contractors selected are suitable for the intended service for drilling, completing, and testing this well. Additionally, Cdn 88 is required to demonstrate to the Board that all personnel employed in this operation are experienced in sour gas drilling operations and hold the necessary certifications.
3. Cdn 88 shall develop a casing bowl welding procedure by a qualified professional engineer to be included in a detailed drilling plan.

4. Cdn 88 shall submit a report respecting the review of steel mill heat certificates for the casing and drill pipe to be used in the construction of the 10-35 well.
5. Cdn 88 shall satisfy the Board that ARP 1.2.5 New Grade E Specifications and/or ARP 1.2.6 SS-95 Drill Pipe Specifications or better will be used for the drilling of the 10-35 well.
6. Cdn 88 shall commit to daily briefings of the EUB Calgary South Field Centre, including submission of daily drilling reports during the critical period.
7. Cdn 88 shall notify EUB Field Surveillance personnel and have them attend pre-spud and pre-critical zones penetration safety meetings.
8. Cdn 88 shall commit to detailed EUB drilling rig inspections prior to spud, and drill out of intermediate casing, including blowout prevention drills.
9. Drilling and testing in the critical zone shall not take place other than during the summer months, in particular, not before April nor after October.
10. Cdn 88 shall demonstrate and implement immediate ignition within one minute of the ignition criteria being met.
11. Cdn 88 shall test all key components of its ERP, including the computerized telephone call out system, communications equipment, communications linkages including outside services, evacuation procedures, and ignition procedures and satisfy the Board that the systems are in order for immediate implementation, prior to drilling into the critical sour zone.
12. Cdn 88 and the MD shall identify sensitive individuals within the additional four-km awareness zone. Additionally, Cdn 88 shall update its ERP to include procedures to notify those designated as sensitive at a level 2 emergency and provide the option to evacuate. All those who are sensitive must be evacuated if the well is ignited.
13. Cdn 88 will satisfy the Board that all individuals involved in implementing the ERP are familiar with the program and capable of implementing it as required. Cdn 88 shall alert the public included in the ERP on the progress of drilling each week until drilling and testing is complete.
14. Cdn 88 shall notify all individuals in the EPZ and awareness zone prior to drilling in the critical zone.
15. Cdn 88 shall provide two air mobile monitoring units stationed at the well site during drilling in the critical sour zone. The Board believes that these mobile air monitoring units and the four stationary monitors located at sub-divisions beyond the four-km EPZ would be adequate to detect and monitor the level of H₂S and SO₂ in the event of an emergency.

16. Cdn 88 shall satisfy the Board that adequate municipal and provincial resources would be available to assist the MD for protection of the public within its area of jurisdiction. The Board must be satisfied that the MD is prepared to respond regardless of the type of emergency. The Board expects a written agreement between Cdn 88 and the MD to be finalized and submitted to the Board prior to drilling.
17. Cdn 88 shall review details of the ERP and update all information including resident information, mapping, emergency contacts, and resources and submit the final plan to the Board for review and approval prior to drilling.
18. Cdn 88 shall work with all affected emergency planning organizations to prepare contingency plans in the event of an emergency.

Issued at Calgary, Alberta, on 7 July 1999.

ALBERTA ENERGY AND UTILITIES BOARD

[Original signed by]

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

[Original signed by]

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

[Original signed by]

G. J. Miller
Board Member

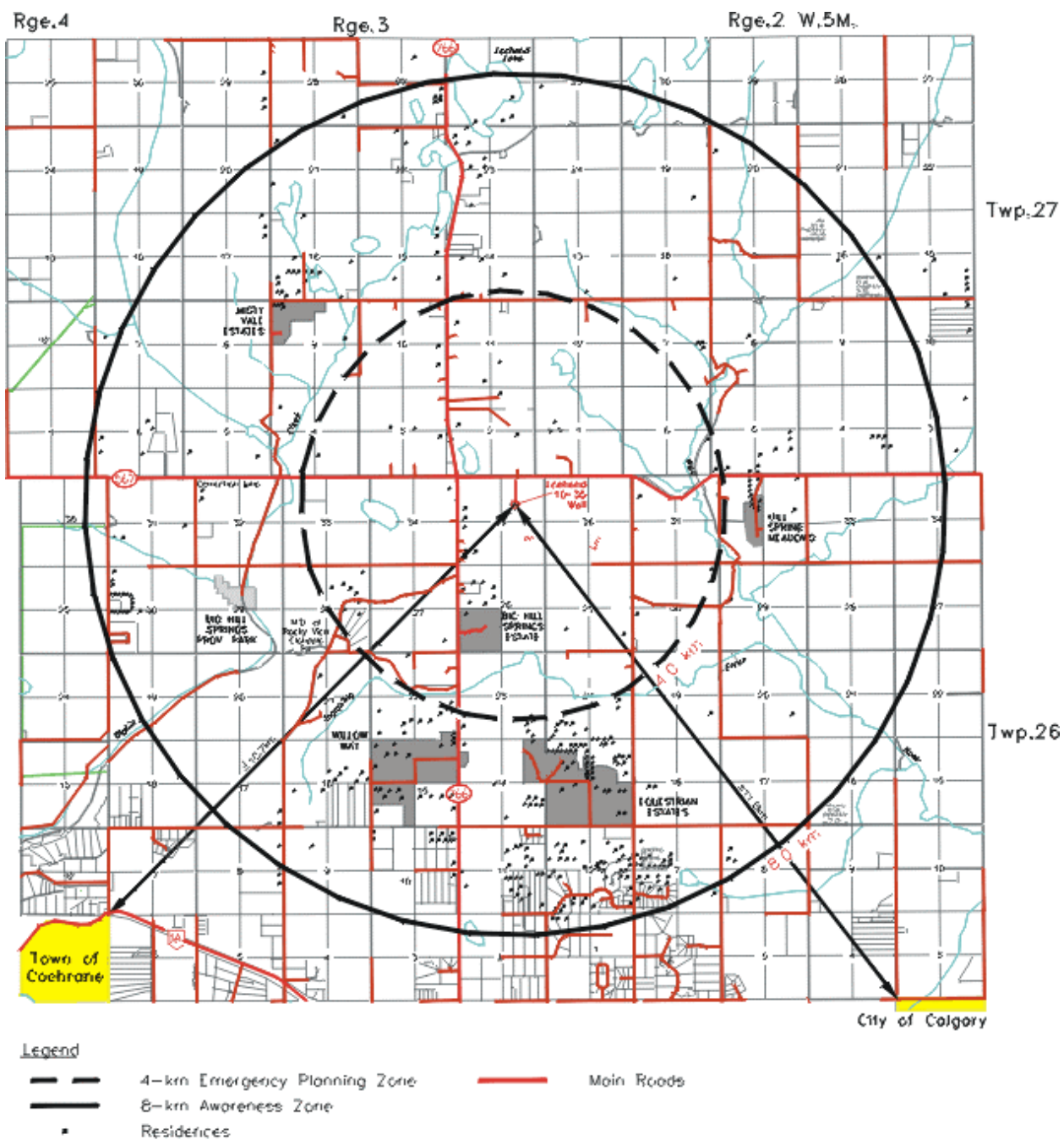


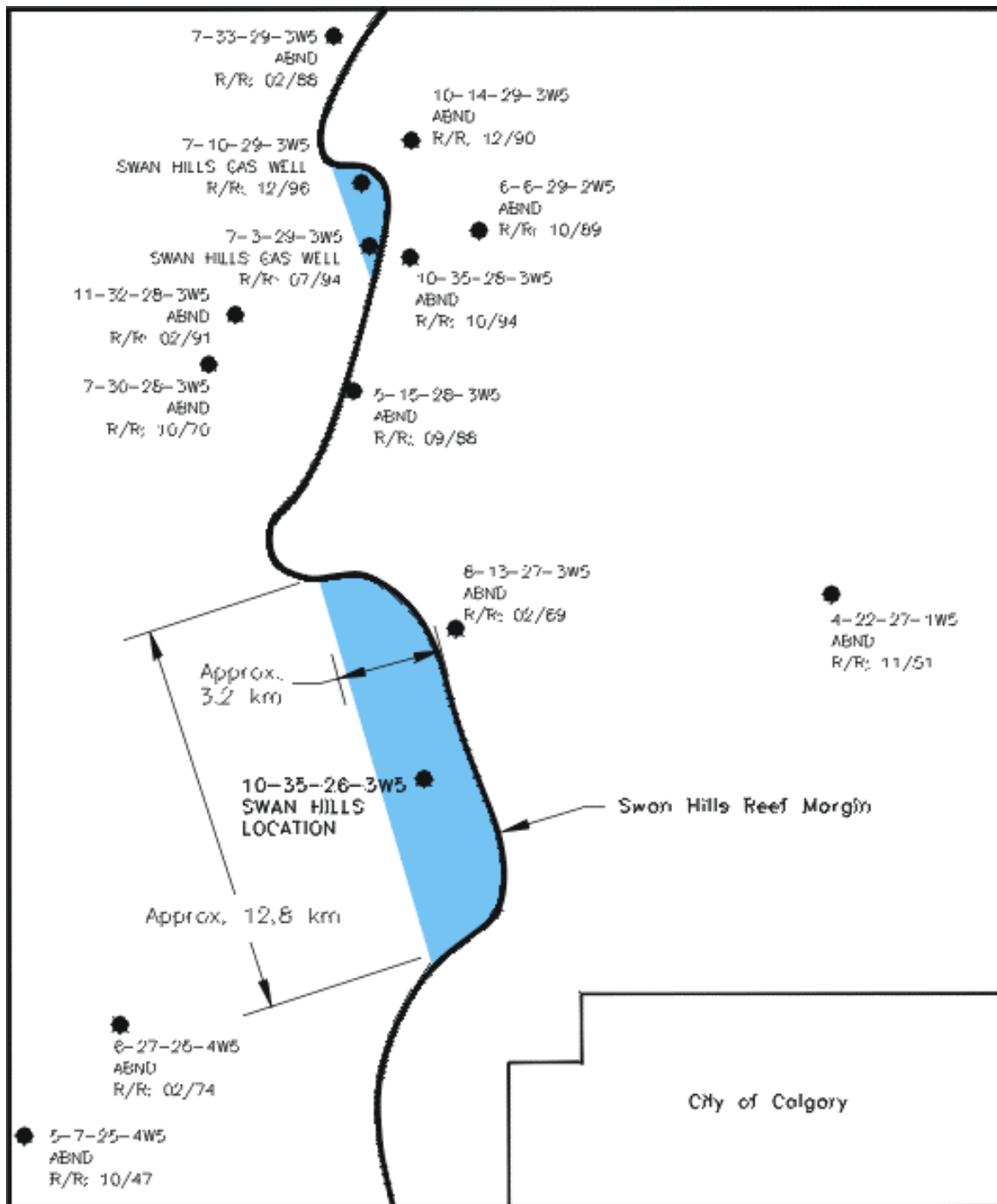
Figure 1
Emergency Planning and Awareness Zones

Application No. 970473

Canadian 88 Energy Corp.

Decision 99-16





Legend

ABND - Abandoned
 R/R - Rig Release

Potential Swan Hills Gas Pools

Figure 2
 Swan Hills Reef Margin Lochend Field
 Application No. 970473
 Canadian 88 Energy Corp.

Decision 99-16

