BOARD ADVICE RE:

MANAGEMENT REPORT TO THE HEALTH & SAFETY COMMITTEE OF SOLID ENERGY NEW ZEALAND LIMITED ON THE RE-ENTRY OPTIONS INTO THE PIKE RIVER MINE DRIFT

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1.0 Introduction

This advice is to the Health and Safety Advisory Committee (HSAC) of Solid Energy New Zealand (SENZ). It relates to the confidence that the HSAC is entitled to place in the risk management process that underpins a report, dated 29 October 2014, to the HSAC by SENZ management concerning the risks associated with options for re-entering the Pike River drift. The advice is based on monitoring and reviewing this process over its full duration of some 18 months, having regard to the following risk management standards and guidelines:

- *AS/NZS/ISO 31000:2009 Risk Management – Principles and Guidelines* (AS/NZS/ISO 31000, 2009)
- *MDG 1010: Risk Management Handbook for the Mining Industry* (MDG-1010, 2011).
- *Solid Energy Health and Safety Management System – Standards, Version 2* (Solid Energy New Zealand, 2013
- *MDG 1014: Guide to Reviewing a Risk Assessment of Mine Equipment and Operations* (MDG-1014, 1997).

These standards and guidelines form the foundations of a risk-based approach to managing principal hazards, consistent with the recommendations of the Royal Commission into the Pike River disaster and the Queensland style of mining legislation that the New Zealand government is subsequently adopting.

2.0 AS/NZS/ISO 31000:2009

Figure 1 shows the risk management process as detailed in AS/NZS/ISO 31000:2009. The reiterative nature of the process in developing and testing controls to reduce risk and the risk assessment of proposed controls to determine residual risk are essential elements of this process. Both are critical to the confidence that the Solid Energy Board, through its HSAC, can place in the outcomes of the risk assessment process and upon which management's report to the HSAC is based.

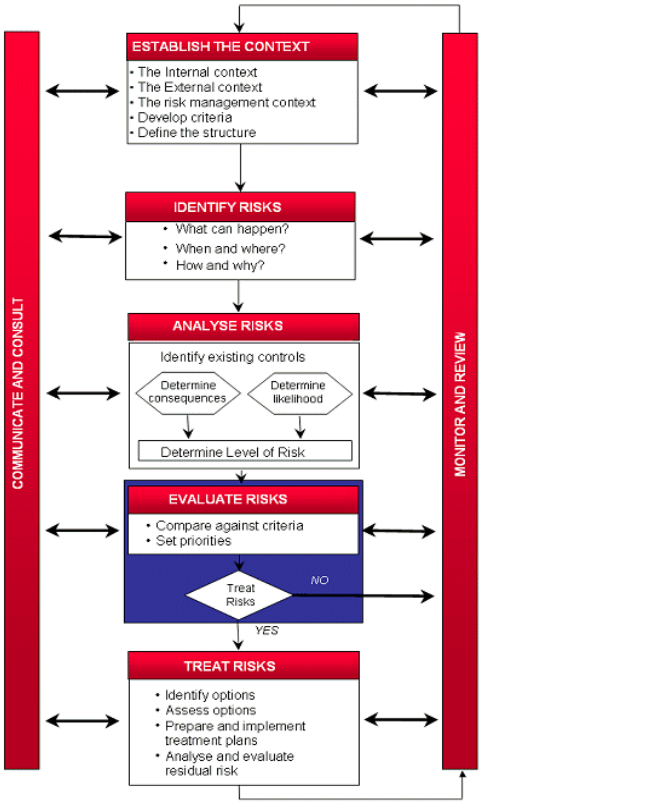

Figure 1: The Risk Management Process as detailed in AS/NZS/ISO 31000:2009 (extracted from Pike River drift re-entry risk assessments).

Advice No. 1: Management's report and the underpinning risk assessments have had due regard to and are generally consistent with AS/NZS/ISO 31000:2009.

3.0 MDG1010

MDG 1010 describes the principles of risk assessment, the essential features of a risk assessment, a range of risk assessment techniques and circumstances in which they find application. It notes as a key point that *there is no single "correct" way of undertaking a risk assessment or risk management initiative, but there are principles which should be observed*.

The following two essential features identified in the guideline are of particular note in regard to risk assessing options for re-entering the Pike River drift:

- *Use of a team with appropriately varied and relevant experience of risk identification*.

  As the Pike River re-entry process evolved and the risks and potential controls came to be better understood, the composition and structure of the teams involved in the risk assessment process were varied, consistent with sourcing the knowledge, experience and skill appropriate to properly assessing the risk. Most importantly and critically, this included objectively risk assessing the proposed controls. This latter process took a number of forms that ranged from the initiating risk assessment team through to the Project Steering Committee, which comprises representatives of the project team, the SENZ executive and external expertise. This has been complemented with technical assistance in the areas of geotechnical engineering, ventilation and process control.

- *Identification of both those high risks which need to be reduced, and those possible high consequence events which need to be prevented.*

  As the nature of the risks came to be better understood through bow tie risk analysis, it became apparent that no controls could ever ensure that some 'top events' (such as entrapment) could not occur during drift re-entry, albeit that the probability of these events occurring might be considered low. Therefore, a need evolved to place a high focus on if and how such events could be responded to effectively in emergency circumstances.

The risk assessment process has revealed that the re-entry of Pike River drift is a deceptively complex. It is normal with complex projects that risk identification, risk understanding and risk treatment options evolve over time. This requires multiple iterations and variations in the risk assessment process. The Pike River re-entry project is no exception.

Advice No. 2 – Management's report to the HSAC is based on a risk assessment process that is consistent with the principles espoused in the MDG1010 guideline. There is opportunity for some enhancements (such as more detailed documentation of reasoning and formal sign-off of participants) but these are of a nature that do not impact on the outcomes of the risk assessment process.

4.0 SENZ HSMS

Element 2 of Solid Energy's Health and Safety Management System comprises a series of standards relating to risk management, Figure 2. In reviewing the Pike River drift re-entry risk assessment process, I have had particular regard to Standard 2.1 – Hazard/Risk Management Framework and Standard 2.5 – Emergency Management. Standard 2.1 identifies the various types of risk assessment tools to be adopted within SENZ, commensurate with the risk. In the case of the Pike River re-entry project, the initial risk assessments were based on the Workplace Risk Assessment and Control (WRAC) process for level 3 risks as defined in Standard 2.1. The high level risks identified from this process were then elevated to Level 4 risks, requiring the development of high risk management plans.

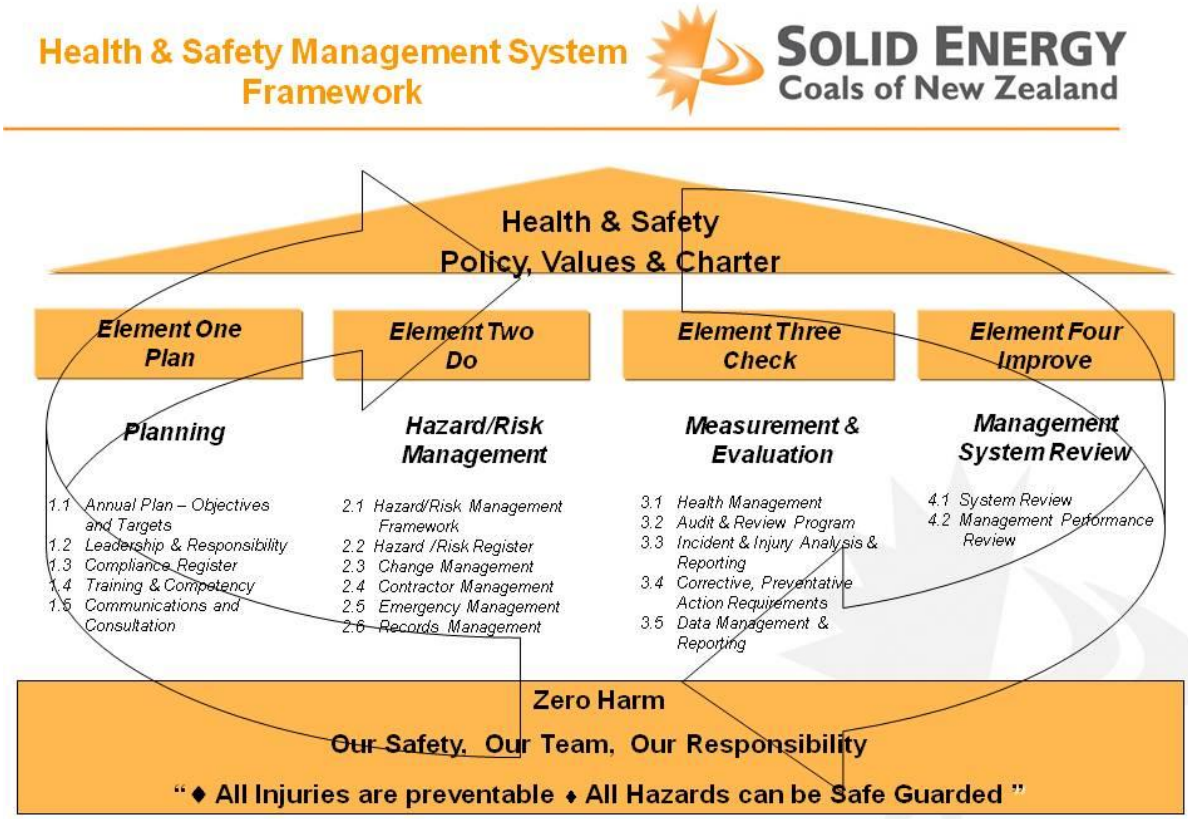

Figure 2: Structure and composition of Solid Energy's Health and Safety Management System

Consistent with international risk management standards and guidelines and with Solid Energy's Health and Safety Management System, analysis and assessment of Level 4 risks (High and Very High) has been based on Fault Tree analysis and Event Tree analysis.

Fault Tree analysis provides detailed insight into how events may arise that present a risk to health and safety and gives direction to the identification of additional and/or more robust

controls to those identified in the WRAC process and to the assessment of their likely effectiveness.

Event Tree analysis provides detailed insight into the range of consequences that may arise out of a critical event. It is important for informing stakeholders of residual risk and for developing contingency plans that permit an immediate response to a critical event.

Event tree analysis is a powerful tool for developing effective Emergency Response Plans for high and very high risks. In this particular matter, I consider it essential. This is because despite a number of scenarios being risk assessed, the risk of entrapment is yet to be eliminated. Therefore, it is critical that the consequences of entrapment are risk assessed at this stage of the decision making process in order to appreciate the level of confidence that can be placed in entrapped persons being successfully rescued. It is important that all stakeholders appreciate this residual risk.

Advice No. 3 – Management's report to the HSAC is based on a risk assessment process that is consistent with Solid Energy's Health and Safety Management System.

5 MDG1014

MDG 1014 provides guidance on reviewing a risk assessment for its robustness. The following is a list of common faults that the guideline advises should be looked for when reviewing a risk assessment, with my comments added where relevant.

- *Omission of credible accidents or incidents* – described as *'perhaps the most important weakness'*.

  This potential pitfall has been addressed by the Project Steering Committee, particularly through its consideration of historical events.

- *Unwarranted optimism* – described as *an insidious trap which can catch not only members of the organisation itself but also "independent" consultants. A consultant who works closely with the client (as is very desirable) finds himself or herself unconsciously becoming a member of the clients "team", and viewing the proposals through the client's eyes. Further, no consultant wants to admit to a client an inability to define adequate safeguards. (It is necessary for a risk consultant to ask himself or herself frequently "Is this a balanced view, looked at from the outside?")*

  This potential pitfall has been challenged in various forums during the risk assessment process. Consistent with robust risk assessment, the Project Steering Committee, complemented with technical assistance in the areas of geotechnical engineering, ventilation and process control, have place a high focus on addressing this potential weakness when reviewing high and very high risks.

- *Unstated or unsupported assumptions – A major problem arises from implicit and unstated assumptions, and from stated but unsupported assumptions.*

  In my opinion, some aspect of the risk assessments that underpin management's report would benefit from more detailed recording of foundations assumptions.

- *Use of risk assessment to justify a predetermined position or decision – Risk assessment has often been used to justify a previously made decision or an existing situation. In such circumstances the staff involved may feel a real or imaginary pressure to adjust the assumptions or data to produce a result which will be acceptable to management*.

  This potential weakness, which is not uncommon, has been challenged by a number of persons throughout the process (including myself), culminating in review by the Project Steering Committee and its geotechnical engineering, ventilation and process control technical advisors.

- *Omission of "common mode" failures – in which several apparently independent "barriers" can be weakened by a single cause common to them all. For this reason, where a high-consequence event is reported to be prevented by several "barriers", the reviewer should actively look for ways in which a weakness in one barrier could increase the chance of weaknesses in the other barriers.*

  This is a very relevant to the Pike River drift re-entry project, especially given the very large number of control procedures (+600) that have been proposed as a pre-

condition to permit re-entry (Note that reliance on such a large number of procedural controls, in its own right, can introduce or even elevate risk). It should be noted that no reliance can be placed on these controls proving effective until they have been risk assessed in their own right. This work is still outstanding. If the risk assessment process were to proceed to the next stage, risk assessment of these controls would need to take into account interaction and interdependence between them. By way of example, loss of electric power supply or a seismic event could, in turn, negate a number of controls.

- *Difficulty of estimating the likelihood of human error - One of the reasons for regarding human error assessment with care is that the methods for identification and estimation of human error probabilities have a number of important limitations. These include the capacity of people for making creative and unusual errors, and the fact that many plant accidents have been traced back to human errors of a type which would have been difficult to identify before the event, or difficult to quantify if identified.....For this reason, the reviewer should give close attention to situations in the assessment report where human reliability is critical to safety, and should encourage those responsible for the activity to consider additional backup measures, preferably of a "hardware" type.*

Many of the proposed controls associated with the Pike River drift re-entry options are vulnerable to human error. This is an area that will require much more thorough risk analysis and assessment if the project does proceed to the next stage.

Advice No. 4 – The risk assessment process upon which Management's report to the HSAC is based appears to have been alert to the common faults associated with risk assessment and to have addressed them to the extent necessary to formulate the conclusions presented in the report.

6.0 Overall Advice

With the benefit of more experience in the risk assessment of complex and high risk activities, aided by the benefit of hindsight, the risk assessment process might have been undertaken in a more streamlined manner by SENZ management. However, this is a common state of affairs in risk assessment of complex situations and in no way detracts from the risk assessment findings and conclusions drawn from the process by SENZ management in its report to the HSAC.

Based on my knowledge and experience, it is my opinion that the HSAC of SENZ is entitled to have confidence in management's report and conclusions having being founded on a robust risk assessment process.

References

AS/NZS/ISO 31000. (2009). Risk Management - Principles and Guidelines. Geneva: International Standards Organisation.

MDG-1010. (2011). *MDG 1010: Minerals Industry Safety and Health Risk Management Guideline*. Sydney: NSW State Government.

MDG-1014. (1997). *MDG 1014: Guide to Revewing a Risk Assessment of Mine Equipment and Operations*. Sydney: NSW State Government.

Solid Energy New Zealand. (2013). Health and Safety Management System - Standards. Version 2. Christchurch.

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