Appendix 14

Radiation Management Plan

REPORT TO COMPASS RESOURCES LTD

RADIATION MONITORING AND MANAGEMENT PROGRAM

1. INTRODUCTION

Compass Resources NL has had submissions, in regard to uranium, to its PER for the Browns base metals project in the Northern Territory. These submissions are being addressed in a supplementary PER due to be submitted in early February 2006. Whilst our earlier report noted the presence of only background levels of uranium at the Browns deposit, one aspect of the submissions received calls for an appropriate uranium and radiation monitoring program (management plan) to be in place. The proposed monitoring program would be included in the supplementary PER.

ANSTO Minerals was requested by Compass to prepare a preliminary "in principle" operational monitoring program to track any build-up of uranium and radioactivity that may occur anywhere from mining, ore stockpiling, plant processing, water management (including process water dam and sedimentation dam) and waste disposal, together with management protocols to follow up the results from monitoring to ensure that dose/exposure limits to the public, the workforce and the environment are not exceeded.

This report presents the recommended Radiation Management Plan (RMP) prepared by ANSTO.

2. BACKGROUND

Mining at the Browns Oxide Project will be carried out using an open-cut method. The potential for significant exposure from radon/radon progeny is therefore minimal.

The Browns project processing flowsheet comprises mining, coarse ore storage, SAG milling, tank leaching with sulphuric acid, solids/liquid (S/L) separation by thickening, copper solvent extraction (Cu SX) and electrowinning (EW), with recovery of Co and Ni from a Cu raffinate bleed by precipitation using sulphide chemicals such as NaHS. The leach thickener underflow will pass to a resin-in-pulp (RIP) circuit to scavenge any remaining dissolved metals, with the resulting resin eluate joining the feed to Cu SX. Tailings will be sent to a tailings dam, along with Fe and Mn precipitated from bleed streams. Plant water will be re-used. Allowance will be made for some water discharge from the site, if it meets the regulatory discharge quality standards or it will be treated (a lime based precipitation of heavy metals from water is proposed) if required, to ensure discharge water quality standards are met.

A detailed monitoring and management program should be developed to meet all requirements. The radiation monitoring and management plan (RMP) should be incorporated into the Mine Management Plan (MMP). The RMP will evolve with the development of the project, as specific areas (critical groups and process areas) are identified. Reporting is not expected to be excessive and might be comparable to that required of the heavy minerals industry, where areas (monazite processing) and products (radium bearing scales) have been identified to be potentially radiological significant.

3. RADIOACTIVITY MONITORING AND MANAGEMENT PROGRAM

Process stream sampling for assay is carried out in conjunction with site radiation monitoring. External gamma measurements will identify any build up of radionuclides inside sealed plant equipment. Analysis of samples for alpha and beta emitters is more sensitive than external gamma measurements and will indicate lower concentrations of radionuclides, which have the potential to build up in the plant equipment. Sampling in association with plant mass flow data provides valuable information in understanding how any radioactivity is behaving (deportment) through the process.

Previous analytical work by Compass Resources indicated that naturally occurring radioactivity associated with the Browns project is due primarily to the presence of ^{238}U in the ore. Radionuclides in the ^{235}U and ^{232}Th decay chains may still become significant, if such radionuclides accumulate in the process. The nature of any continued monitoring requirement for the project should depend on the results of background data collection currently being carried out.

3.1 Sampling and Assaying Program

Regular sampling and assaying of process streams is required to assess the likelihood of build-up of radionuclides. Build-up which may occur in such hydrometallurgical circuits, include:

- ^{226}Ra accumulation in recycled process water circuits in the form of radium bearing process scales on equipment surfaces;
- ^{226}Ra accumulation on equipment due to adsorption ("plating") onto rubber and other synthetic construction material/equipment surfaces, *e.g.* filter cloths;
- uranium and thorium accumulation in recycled SX raffinate; and
- uranium concentration in solution purification products.

Accumulation of radioactivity will depend on the natural bleed-off of various streams in the process. Sampling and monitoring during the first 6 months to 2 years operation will identify whether or not radionuclides are accumulating.

Any changes introduced to the circuit, *e.g.* filter medium, surface coatings modifications etc, will need to be assessed with regard to the potential for radionuclide accumulation.

Analysis should initially be done by delayed neutron counting (DNA) for uranium, and gamma spectrometry for decay chain progeny. In time, this information may be able to be obtained by more conventional methods, by Compass, as knowledge is gained on the behaviour of any radionuclides in the process.

Gamma spectrometery is required for ^{226}Ra determination and to detect the possible accumulation of radioactivity from other decay chains, which are less prevalent in the ore, *i.e.* the ^{232}Th and ^{235}U decay chains.

Monitoring of radionuclides, *e.g.* ^{238}U, in any seepage water from ore stockpiles and waste disposal facilities is also required.

Table 1 is a preliminary list of samples requiring routine assaying (say quarterly) for their contained radioactivity. Many of the samples would be collected as part of the broader plant control and non-radiological environmental monitoring systems.

TABLE 1

Sampling Schedule

Process Stream			Assays	Method
N$^{o.}$	Description			
1	Ore	solids	U	DNA, XRF, other
2	Leach solution	solution	U, progeny	ICP MS, gamma spectrometry
3a-x*	Process scales	solids	^{226}Ra	gamma spectrometry
4	SX raffinate	solution	U, progeny	ICP MS, gamma spectrometry
5	SX other	solution	U, progeny	ICP MS, gamma spectrometry
6	Co/Ni precipitate	solids	U	DNA, other
7a-x	Ore and waste stockpile seepage	solution	U	ICP MS
8a-x	Tailings facility seepage	solution	U, progeny	ICP MS, gamma spectrometry
9	Treated water	solution	U, progeny	ICP MS, gamma spectrometry
10a-x	Bleed stream products	solid	U, progeny	DNA, gamma spectrometry
		solution	U, progeny	ICP MS, gamma spectrometry
11a-x	Green tissue (local plants, crops)	solids	U, progeny	gamma spectrometry
12a-x	Dusts and air samples	solids	U, progeny	DNA, gamma spectrometry
13-x	Other streams as identified in early surveys for radioactivity	solutions and solids		

* the number of samples will vary depending on experience gained

3.2 Radiation Surveys

Radiation surveys should be undertaken early in the life of the operation (after 6 months to one year) to obtain base line radioactivity concentrations associated with the process. The build-up of radioactivity in such circuits is usually very slow and a survey earlier than after 6 months of operation is not normally recommended, unless routine analyses (discussed above) suggest that an earlier survey is warranted. Base line data will be available for the site prior to commencement of mining operations The survey should be repeated after extended plant operation (2 to 3 years) to ascertain whether radioactivity concentrations are increasing due to the process chemistry, and and/or changes in ore and operating practices/procedures and equipment. The radiological effect of some of these changes are often not realised by the operator at the time.

The frequency of radiation surveys is determined by the history of results obtained from previous surveys of the operation (including base line data collected prior to commencement of mining activities). Contaminated equipment and its disposal is frequently the only significant issue arising from radioactivity accumulation. This is often detected during routine (6 month to yearly depending on the previous results and potential for exposure) site surveys.

Measurements taken over the operation during site surveys should include:

- external gamma – the source radionuclides can be identified;
- radon gas and progeny; and

- dust loadings and the radioactivity content of the dusts.

The identification of critical groups by examination of work conditions, *i.e.* occupancy time, proximity to naturally occurring radioactive sources, dust loadings *etc* may require that such groups be subject to monitoring (TLD).

3.3 Reporting

Reporting should be in accordance with regulatory requirements. This will demonstrate, to all stakeholders, that sufficient data is available to show that:

- radioactivity is not accumulating in the process, with the associated potential for increased exposure to the workforce and public; and/or
- radioactivity, which is accumulating or is present in significant concentrations, is being managed in an appropriate way.

The creation of a data base will also identify:

- critical workforce groups or individuals;
- any elevated radioactivity concentrations and/or dose measurements; and
- the effects of the implementation of appropriate controls, *e.g.* occupancy, use of PPE, following specific procedures *etc*.

3.4. Management Strategies

Management protocols include;

- establishment and development of a Radiation Management Plan in association with the regulatory authority as part of the MMP;
- regular (annual) reporting on agreed assaying and survey results; and
- regular (annual) reporting on results of actions on issues identified in previous reports.

  e.g. monitoring of groups or individuals exposed to elevated doses and measures taken to reduce the doses in future,

  the practice agreed on with the authority for the disposal of any specific identified contaminated items of equipment, etc.

Compass should ensure that:

- responsible officers are designated to ensure that the RMP meets the regulatory requirements;
- the RMP and reports are submitted as required (contents, timing and changes / amendments);
- measures are taken to control the exposure of employees and members of the public by:
  - use of appropriate equipment and procedures;

- having a monitoring program in place;
- using appropriate dose assessment procedures;
- using appropriate incident reporting procedures;
- having instruction and training programs;
- designating controlled or supervised areas;
- including a suitable waste management systems (restricted release, storage/disposal, decommissioning and rehabilitation relation to radioactivity);

Best practice should be adopted in carrying out the requirements for radiation management.

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January 2006