The Honeymoon Project
Australia's First In Situ Leach Uranium Project

M C ACKLAND, President and CEO, Southern Cross Resources Inc.
PO Box 1513 Toowong Queensland 4066

SUMMARY The Honeymoon uranium deposit is one of several roll front uranium deposits in South Australia. It was discovered in 1971, the project developed in the 1970's, and was ready for demonstration of the In Situ Leaching (ISL) production techniques by January 1983, when the project was stopped, despite it having met the environmental approvals to proceed, for political reasons; the ALP's "three mines policy". From 1983 until March 1996 the project was mothballed.

In late 1996 Southern Cross Resources Inc. (SCRI) reached agreement with MIM to purchase its uranium interests in Honeymoon, Goulds Dam and EL 2310 whilst simultaneously acquiring Sedimentary Holdings NL's interests in EL 2310. By April 1997 these interests were consolidated in SCRI's wholly owned subsidiary, Southern Cross Resources Australia Pty Ltd which is the operating company. Activities are presently underway to rehabilitate the existing treatment plant and continue the program that was outlined in the approved 1981 Honeymoon Environmental Impact Statement.

The program involves the development of Australia's first In Situ Leaching (ISL) mining project.

1 INTRODUCTION

The Honeymoon uranium deposit is situated some 80 kilometers NW of Broken Hill in the Frome Embayment area. The resource identified consists of the Honeymoon deposit and its contiguous extension, Honeymoon extended and East Kalkaroo which occurs in EL 2310. The size of the resource is tabulated in Table 1. Included in this table is the Gould's Dam deposit that is situated 75 kilometers to the north west of Honeymoon.

The orebody is located in the convex margin of a major bend in the Yarramba Paleochannel and is situated within coarse grained basal the overlaying clay and paleo valley slope at a depth of about 110 meters. The Yarramba Paleochannel is comprised of three sub-horizontal permeable sand layers, the upper, middle and basal aquifers. These are separated by clay layers, with the uranium mineralisation occurring mainly in the basal sand unit. The aquifers contain water of distinctly different composition. The upper aquifer has some potential for stock watering but the middle and basal aquifers are unacceptable for stock due to the high sulphate, chloride and radium content.

DEPOSIT OR PROSPECT	RESOURCE CATEGORY	TONNES OF U_3O_8	MILLIONS OF LBS	GRADE % U_3O_8
Honeymoon (resources est ISL)	Measured	3400	7.5	0.157
Honeymoon Extension (resource est ISL)	Measured	300	0.6	0.14
East Kalkaroo (resource est ISL)	Indicated	900	2.0	0.14
Goulds Dam	Inferred	2300	5.1	0.14
Yarramba Prospect	Not Determined		-	-
Total Recoverable		6900	15.2	

Table 1. Uranium Resources - Honeymoon and Gould's Dam

2 HISTORY OF THE PROJECT

Exploration for Tertiary sandstone uranium in the Southern Lake Frome Embayment commenced in the late 1960's by Carpentaria Exploration P/L, E.A.Rudd Pty Ltd., and Sedimentary Uranium N.L. In the early 1970's, Mines Administration P/L and Teton Exploration Drilling company did likewise. The exploration philosophy of these groups followed that successfully employed in the Tertiary basins of Wyoming in North America.

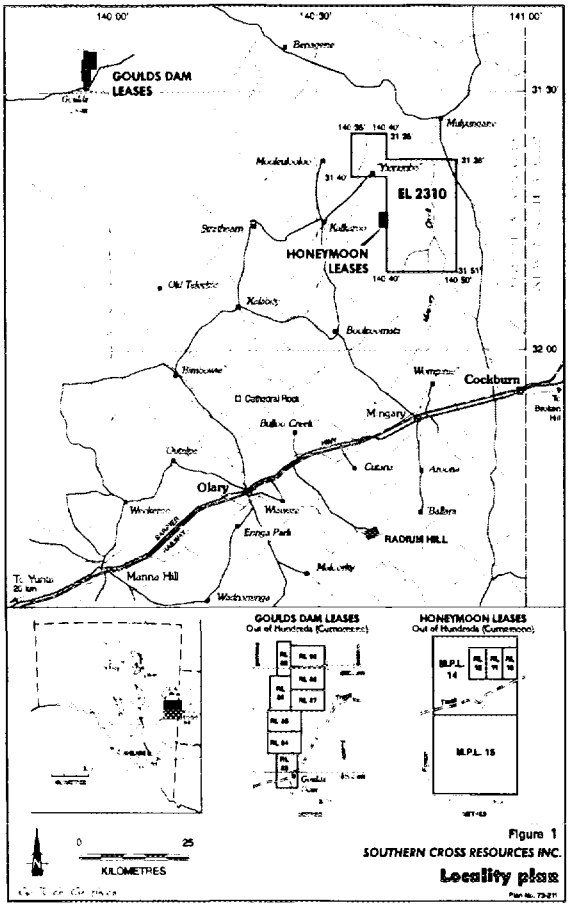

Figure 1. Locality Plan

Regional assessment identified potentially favourable buried fluviate sands adjacent to uranium enriched source rocks. The genetic model assumed leaching from permeable sands, transport down the hydrological gradient and deposition at a reduction oxidation interface.

Exploration methods employed open hole rotary drilling and wireline geophysical logging as a reconnaissance exploration method. Other methods, such as surface resistivity and gravity surveys were also used to locate and map tertiary palaeochannels.

In 1970, Sedimentary discovered the East Kalkaroo deposit and the Yarramba deposit. By November 1972 the Minad Teton JV had discovered Honeymoon and by 1973 the Goulds Dam deposit had been identified. Because of the size, grade and configuration of the Honeymoon deposit, it was decided that the key to the development of these deposits was the successful demonstration of the in-situ leaching technique to recover uranium oxide.

From hereon the project went through a number of stages as data was acquired, the orebody delineated and feasibility studies concluded. The project was now run by a Joint Venture consisting of two major Australian companies and a small North American exploration group, and it would be fair to say at the time progress was slow due to problems associated with one of the partners financial situation. Such delays that this situation caused later became quite important in the project missing the window of opportunity to commence operations.

Key events were as below:

May 1975	Drilling indicates 2220 tonnes of U_3O_8 @ 0.2 % grade.
June 1979	Estimates upgraded to 3400 tonnes U_3O_8 .
July 1979	Second series of Push Pull tests. Meetings with FIRB. Descision to proceed.
Jan 1980	J V Partners agree on parameters for demonstration plant
May 1981	EIS approval by State and Federal Governments
Nov 1981	Commitment to construct demonstration plant
Nov 1982	S.A. State elections- change of Government
Mar 1983	Federal Govt Elections. A.L.P. Three mine policy comes into effect. S.A. Government refuses to grant a production license.

In the period from 1983 until 1996 the Australian Labour Party remained in power in Australia and the uranium industry remained in the doldrums. With the change in government in March 1996 and the abandonment of the " three mines policy" companies were again prepared to dust off the old files and to look at what was happening in the world of uranium.

In May 1996 Sedimentary Holdings N.L., now a gold mining company commissioned a study into the significance of its uranium interests in EL 2310. The

study concluded that whilst ISL treatment of the uranium at East Kalkaroo was feasible, there was a strong case for amalgamating the uranium interests in the area. Accordingly a strategy was implemented resulting in the consolidation of the Honeymoon, Gould's Dam and Tertiary uranium in EL 2310 under the ownership of Southern Cross Resources Australia P/L which is wholly owned by Southern Cross Resources Inc. Sedimentary Holdings N.L. owns some 35% of Southern Cross Resources Inc.

Southern Cross Resources took possession of the properties from MIM on 15 May 1997.

3 DEVELOPMENT PLANS

The present plans for the development of the Honeymoon Property are similar to those that were outlined in the EIS that was approved back in 1981, utilising the plant, albeit rehabilitated that was built in1982.

It is anticipated that the development will proceed in three stages.

- Refurbishment of the Existing Facilities
- A Demonstration Phase
- Commercial Operation

Refurbishment of the existing facilities has commenced, with the appointment of Ausenco Limited as engineers for the plant refurbishment program. The initial site assessment has been completed with the plant being considered to be in remarkably good condition for its age. Whilst there has been some wear and tear as a result of the efflux of time, the major effort required to bring the plant up to operational standard is the reinstallation of those items of equipment that were removed as part of the mothballing process, namely the camp and accommodation buildings, the water supply, the power supply and the other services, along with the miscellaneous equipment and transport.

It is anticipated that the plant refurbishment will be sufficiently advanced to commence commissioning the plant for the demonstration phase in December 1997.

The demonstration phase of the program involves running the plant at a rate of 25 litres per second for a period of approximately 18 months during which time operators and Southern Cross Resources technical staff will develop an understanding and an appreciation of the subtleties of ISL operations. During this period a revised EIS will be submitted to the State and Federal Authorities to cover the operations as they develop both at Goulds Dam, Honeymoon and EL 2310. The exact duration of the demonstration phase will to some extent be dependent upon what is found to be of significance in terms of well field management and the rate of extraction of uranium.

The commercial operation of the plant will follow a plant expansion to lift production to approximately 100 litres per second (equivalent to 460 tonnes U3O8 per annum) or higher depending upon the results of the demonstration phase and markets. It is anticipated that the commercial process plant will be an extension of the existing demonstration plant but incorporating some more up to date high capacity mixer settler combinations and vacuum drying of the yellowcake product.

4 THE PRODUCTION SYSTEM

The production system to be employed at Honeymoon is the use of solution mining that has come to be known generally in the uranium production industry as in situ leaching (ISL). This technique was developed in the United States and now accounts for around 95% of all United States uranium production.

To be amenable to solution mining a uranium deposit must have the following characteristics:

- The ore must occur as a near horizontal body in porous, permeable, undisturbed strata, usually sandstone, confined above and below by impermeable strata.

- The ore should be located below the water table, usually in an acquifer.

- The mineral should be in a form that is readily leached

Basically the technique involves the recirculation of treated ground water through the uranium bearing sandstone formation, to oxidise and solubilise the uranium which is pumped to the extraction plant where the uranium is removed from the leach solution by solvent extraction. The stripped solution is recharged with oxidant and recirculated back to the ore body. In this case the oxidant is an acid ferrous/ferric sulphate solution that will have a ph of 2.8 to 3.0, or in layman's terms will have the same acidity as a good red wine or Coca-Cola!

In the solvent extraction section the uranium is concentrated in an organic phase from where it is stripped to a final aqueous phase from which it is precipitated with a combination of Sodium carbonate and hydrogen peroxide and uranyl peroxide. This product is dried and shipped as a traditional yellow cake product to the customer conversion facility. A diagrammatic flowsheet of

the in situ leaching system is shown as Figure 2 and a general flowsheet of the extraction plant is shown as Figure 3.

The extraction technology used is highly conventional and there is little process risk involved in this area. The art in operating ISL projects is tied up in the interpretation of the ore body characteristics and the management of the well field through the individual well life cycles. In this regard the Honeymoon Project is different from most of the operations in operation today as the oxidant is an acid sulphate rather than a carbonate based oxidant. The differences are summarised in the following paragraph.

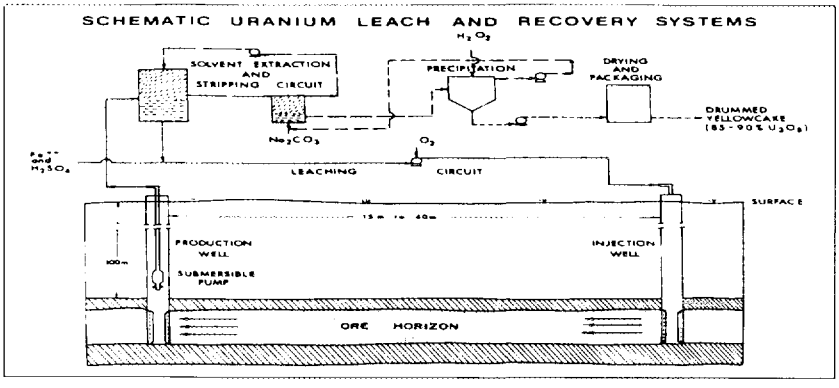

Figure 2. Schematic Uranium Leach and Recovery Systems

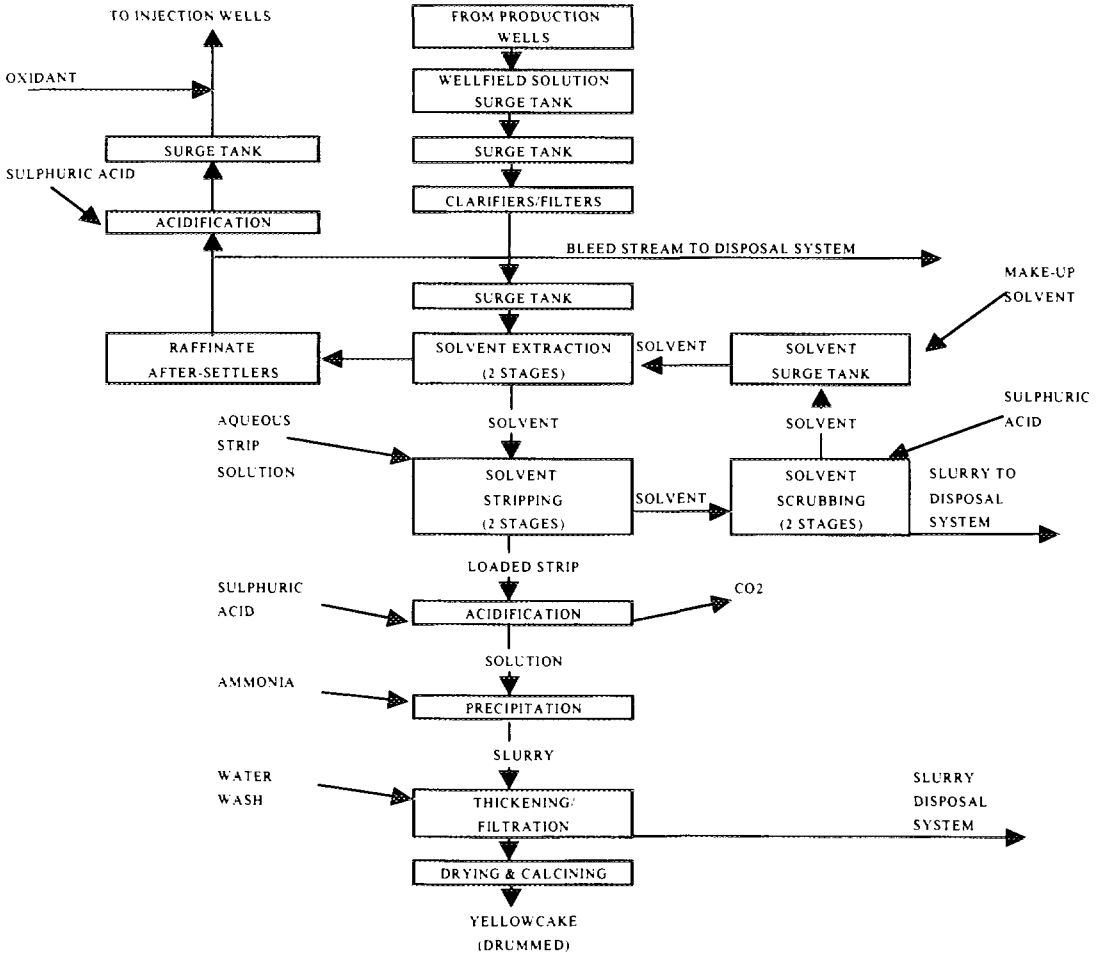

Figure 3. Uranium Process Flowsheet

5 HONEYMOON IN COMPARISON WITH U.S. OPERATIONS

The Honeymoon deposit has the desirable characteristics as indicated in Table 2 where these are shown in comparison with similar operating mines in the United States

	USA OPERATIONS	HONEYMOON
DEPOSIT DESCRIPTION		
Area Size	0.1-5.0	0.24
Subsurface Depth (m)	100-300	110
U_3O_8 Reserves (t)	2,000-25,000	3,360
Average Grade U_3O_8 (%)	0.08-0.15	0.16
Permeability	Low-moderate	High-very high
Aquifer TDS (ppm)	500-4,000 suitable for stock and domestic purposes	15,000-18,000 very saline, unsuitable for stock or domestic purposes
Leach System	Carbonate	Sulphate
Oxidant	O_2	$Fe_2(SO_4)_3$ & O_2
Pregnant Liquor U_3O_8	60-80	150
Preflush or Pretreatment	Not required	Planned – to reduce TDS
Recovery Method	Resin – IX	Pilot plant is SX IX
Groundwater End Use	As before	Remains unusable
INFRASTRUCTURE		
Operational Mode	Near established towns and workforce	Near Broken Hill. Flyin – Flyout, semi desert location
Housing/Accommodation	Not required	Transportable Camp
Electricity	Local Grid	On-site diesel
Airstrip	Not required	Required
Access Roads	Sealed and unsealed	Unsealed
Water Supply (domestic/camp)	Portable quality acquifers	Treated water

Table 2. Honeymoon & USA Operations Comparison

6 ENVIRONMENTAL AND POLITICAL ISSUES

Any new uranium operation faces a plethora of environmental issues that must be addressed to comply with the some twenty one South Australian Government Acts, fifteen Commonwealth Government Acts and four Codes of Practice. Southern Cross recognises that it will have to comply with these acts and at the same time convince the general public that the ISL technique is essentially a very safe and environmentally benign method of uranium production. To this end it is the company's intention to operate in the most transparent manner as possible consistent with good operating practice so that interested may visit the during normal operations to get an appreciation of the technique.

Aboriginal land claims and the Wik decision are another matter that must be addressed by the modern Australian miner. Southern Cross takes the view that negotiation rather than litigation is the way to proceed and anticipates that these matters can be satisfactorily resolved.

7 CONCLUSION

It is now twenty-six years since the discovery of the Honeymoon and associated uranium deposits in the Curnamona Province, and the project has yet to be commercialised. Later and larger discoveries such as Olympic Dam have been developed during a period where the impediments to development were the politics of the Australian uranium policy. With the end of the cold war and the significant reductions underway on weapons stockpiles, the completion of the test bans and the perceived reduction in the threat of nuclear war, there appears to be a reduction in the opposition to nuclear power.

Superimposed on this scenario is the perception that greenhouse gas emissions from conventional thermal power stations are contributing to climate change, and one feels that in some quarters the nuclear power option will be taken to higher levels of production in the coming century. Southern Cross feels that the sentiment towards uranium mining has changed in Australia, although the regulatory and the environmental controls are tending to get tighter rather than more relaxed.

Southern Cross is optimistic that it will be able to negotiate the barriers that lie before all potential uranium producers, that the demonstration stage of the Honeymoon operation will commence operations in January 1998 and that the project will be in operation on a commercial basis by the millenium. We expect that the operation has the potential to rank in the bottom quartile of world wide uranium production costs, and as such we welcome discussions with potential clients.