6.0 Alternatives

6.1 Business Alternatives

Alcan has considered three major alternatives to capture the market opportunities. These alternatives will be benchmarked against the preferred option of a Gove expansion following completion of the Definitive Feasibility Study.

6.1.1 Greenfield project

Alcan continues to investigate the feasibility of investing in greenfield alumina refineries. New opportunities have arisen through Alcan's acquisition of Pechiney in December 2003. The projects currently under consideration are less advanced than the Gove project.

6.1.2 Alternate Brownfield expansion

Alcan fully owns, or has substantial shareholdings in, another six alumina refineries worldwide. A brownfield expansion avoids the high capital cost of a greenfield development as well as providing an opportunity to increase the economies of scale of an existing refinery.

The most competitive alternative refinery for expansion is the Queensland Alumina Refinery (QAL), based in Gladstone, where the feasibility of an expansion to over 5 Mtpa has been assessed. An incremental expansion of QAL is likely to be attractive, however Alcan's share (41%) of the increased production would only be about 600,000 t, well short of the market opportunity. This opportunity is also less advanced than the Gove project.

6.1.3 Buy alumina from third parties

There are a number of alumina suppliers who could potentially underwrite further expansion of their facilities through a direct sale to Alcan. This is sub-optimal for Alcan given the cost of alumina per tonne from a Gove expansion is lower than the long-term purchase contract price for alumina.

6.2 Site Alternatives

The reasons for selecting Alcan Gove as the site for a brownfield expansion include the following:

- Alcan views Australia as an attractive location for growth in its bauxite and alumina business due to availability of a skilled workforce, access to energy, and locally available bauxite;
- Alcan Gove was originally planned as a four-stage refinery and to date it has only been developed to two stages. Hence there is adequate room available within the existing refinery footprint to accommodate the proposed expansion; and
- The existing production capacity of the Gove refinery is not sufficient to enable it to maintain its position in the future as a competitive low cost refinery. Production capacity must be increased to achieve improved economies of scale to safeguard its future viability.

On the Gove Peninsula, there are no logical sites for locating the additional refinery facilities other than at the existing refinery site. Any other locations would result in the unnecessary disturbance of additional areas of land and would reduce the opportunities for economies of scale that occur in developing within the footprint of the existing refinery.

6.3 Process Alternatives

The Bayer process, which is currently used in the majority of alumina refineries around the world, is used at Gove and will be the process to be used for the Third Stage. There are no other alternatives possible for the Third Stage because its process must be compatible with that of the existing refinery.

Alcan has carried out extensive investigations into alternative production process options for various areas within the refinery during pre-feasibility studies, with as many as 20 technical variations and innumerable equipment variations having been considered. The options selected are regarded as having the greatest possibility of being commercially viable while incorporating significant environmental benefits and ensuring the long term success of the mine and refinery.

6.4 Raw Materials Alternatives

The major raw materials used in the refinery are:

- Bauxite sourced from the Gove ore body located to the east of the refinery;
- Heavy fuel oil sourced from overseas supply;
- Seawater sourced locally from Melville Bay;
- Fresh water sourced from an underground aquifer below the bauxite orebody; and
- Caustic soda sourced from overseas supply.

The alternatives considered for each of these raw materials are discussed below.

6.4.1 Bauxite

Using bauxite from the Gove bauxite orebody is the basis for originally developing the mine and alumina refinery as one integrated operation. Adequate reserves of Gove bauxite are estimated to be available within approved lease areas to supply the proposed expanded refinery for around the next 27 years to year 2030. Other bauxite deposits exist in the Gove region, however these are located outside the approved lease area and are of unknown quality. Development of these reserves will be considered as a potential future source of bauxite for Gove operations. Once the bauxite resources at Gove are near exhaustion, the refinery will consider sourcing bauxite from an alternative resource elsewhere in Australia or from overseas. The expanded refinery will have a nominal period of operation of 50 years.

6.4.2 Fuel

As outlined in Section 5.3, it is proposed to continue to use fuel oil until a supply of natural gas is secured.

The only other alternative is coal. Coal has several disadvantages. It would need to be sourced from resources elsewhere in Australia or overseas as there are no local viable supplies. There would be a considerable number of ship movements required to bring coal to Gove. Additional facilities would need to be constructed to unload and

stockpile coal. Burning coal could also increase air emissions. Coal would be suitable only at the steam power station as it is not suitable as a fuel for the calcination and lime processes.

6.4.3 Fresh Water

The three potential sources of fresh water for the operations are as follows:

- Desalination;
- Surface storage; and
- Groundwater.

A desalination plant is expensive to construct and operate and uses significant electrical energy. For these reasons, desalination would only be considered if the alternatives of surface storage or groundwater were not feasible.

A surface storage facility with the capacity to provide a secure source of the required volume of water for the mine, refinery and the town would be substantial. It would need to be located on one of the existing natural river systems in the region and would result in disturbance to the surrounding environment and the river's natural flows and ecology. In addition, a new pipeline would be required from the storage facility to the refinery, which would result in additional disturbance of natural bushland. Any storage facility of sufficient size is likely to be located outside of the existing lease areas. Furthermore, the region is exposed to high evaporation water loss associated with surface ground storage facilities.

The water supply for the refinery, mine and Nhulunbuy is sourced from local wells, which remain the preferred source for the expanded refinery. Much of the necessary infrastructure is already in place. However, the additional demand from the expansion will require additional wells to be installed. Demand management will be put in place with the aim of remaining within the supply capacity and licence limits of the existing wellfield. In addition, the optimum location of the additional wells has been identified and approvals for their installation sought. The location has been determined by modelling to ensure that existing surface flows are not detrimentally affected. The extent of disturbance required to install new wells is significantly less than that required for any new surface storage facility.

6.4.4 Seawater

Seawater is used for evaporation cooling within the existing refinery, where the water evaporated from caustic liquor is condensed and re-used for washing in the process. It is also occasionally used for condensing turbines at the steam power station. Seawater will continue to be used for these purposes in the Stage 1 and 2 components of the expanded refinery. The Stage 3 evaporation component has been designed to use fresh water cooled through cooling towers. The alternative of using seawater for the Stage 3 evaporation was considered, however it is a less environmentally attractive option because it would increase the discharge of heated seawater and the risk of precipitate discharge to the marine environment.

Using seawater for the neutralisation of some of the waste water and residue offers the most attractive of the many alternatives that could be applied in a neutralisation process. The other alternatives generally require higher energy consumption and the use of more equipment and chemicals to achieve adequate neutralisation. These alternatives would be less favoured than the use of seawater.

6.4.5 Caustic Soda

Caustic soda is an essential ingredient in the Bayer process. There are no feasible alternatives to its use in this process. Alcan Gove takes all possible steps to maximise the reuse of caustic soda.

6.5 Environmental Management Technology Alternatives

6.5.1 Treatment of Residue Waste Water

The options available for residue treatment are to continue with the existing system or to introduce a neutralisation system for waste water.

At present, the residue waste water is disposed of in an alkaline condition at the residue disposal area (RDA). Some of the waste water is returned to the process and some of it is neutralised in the labyrinth to enable it to be discharged to Melville Bay via the refinery outfall. However, the current process does not consume all of the waste water and the remaining amount (which varies according to the rainfall received) accumulates in the RDA. One alternative is to continue with this existing system for the expanded refinery. However, to reduce the environmental risks of long term storage of alkaline waste water, an alternative treatment process is proposed. This process includes the introduction of a waste water neutralisation plant as described in Section 4.5.3. This process will conserve raw materials and reduce the waste water inventory because the neutralised waste water will be suitable for discharge to the marine environment.

6.5.2 Treatment of Residue

Alcan Gove proposes to move towards neutralising residue with seawater before sending it to the RDA, rather than continuing to dispose of caustic residue as at present. By 2015, all of the residue going to the RDA will be neutralised with seawater. The runoff from the neutralised residue will be saline and suitable for discharge to the marine environment. Revegetation of the residue will be more effective because the saline sand component of the residue can be used as subsoil. This use of residue sand has already been proven in research trials at the RDA.

6.5.3 Residue Disposal Areas

The following alternative scenarios have been considered for extending the life of the existing RDA:

- Future stacking of residue in Ponds 6 and 6 North but only the eastern end of Pond 5;
- Filling Pond 5 completely with residue and retaining Ponds 6 and 6 North for waste water storage; or
- Filling Ponds 5 and 6 to a lower final height and developing a new area to the north of the conveyor.

The first option is the preferred alternative because it has a lower final stack height, it has a smaller final area for rehabilitation, and it does not require the use of any land outside of the existing RDA footprint.

6.5.4 Evaporation Cooling

As discussed in Section 6.3.4, seawater cooling water from the existing Stage 1 and 2 evaporation plant is discharged to Melville Bay. If Stage 3 evaporation was to use the same technology as Stages 1 and 2, there would be an increase in the heat load and the precipitate load discharged to the bay. The proposed alternative is to use a closed circuit freshwater system for evaporation cooling for Stage3. This will avoid the need for any additional cooling water discharge to Melville Bay.

6.5.5 Air Pollution Control Technologies

For dust control from alumina calciners, electrostatic precipitators have generally been favoured at Gove over bag filters because of issues such as elevated waste gas temperature, reliability to maintain good filter cloth condition, and better suitability for tropical environments. The final selection will be made during the detailed design process.

Alternative stack heights were assessed as part of the studies on air quality impacts and the most economically viable alternative resulting in acceptable air quality was chosen.

6.6 Workforce Accommodation Alternatives

The two alternatives available for the accommodation of the additional workforce required for the expanded refinery are permanent accommodation in Nhulunbuy or accommodation suited to a fly-in/fly-out operation. This latter arrangement is when the workers stay in unit style accommodation during their period of rostered working days and then leave the site for their rostered non-working days

Permanent accommodation will be in the form of either single person units or houses for families. New houses and units will be available for use by the additional operational workers. Employees living in the new houses will reside permanently in Nhulunbuy while the residents in the units are likely to be employed on a fly-in fly-out basis.

6.7 Construction Alternatives

Two alternative methods for the construction of the Third Stage Expansion have been considered.

The first alternative is conventional construction whereby all the basic construction materials are imported to Gove and assembled on-site. This also requires all of the construction workers to be located on-site. It is estimated that the peak on-site construction workforce for this alternative would be approximately 1,700. To have such a large number of contractors on site, in addition to regular operations personnel, would increase the risk of serious injuries occurring.

As an alternative, consideration has been given to reducing the extent of conventional construction to be undertaken on-site by pre-assembling major items of equipment off-site and then shipping them to site for installation. The advantages of this approach include the following:

- Reduction in on-site construction employees to a peak of up to 1,200;
- Reduction in on-site accommodation services required for the additional construction workforce;
- Reduction in the demand for on-site infrastructure services including water sewerage and power;
- Less on-site congestion during construction which is important when the existing refinery operations must continue;
- Improved construction safety;
- Smaller construction laydown areas required with reduced need to clear land; and
- Reduction in construction wastes generated on-site and reduced disposal requirements.

Because of these benefits, the use of pre-assembled modular construction is the preferred alternative.

6.8 "No Go" Alternative

The cost of the "no go" alternative would include the following:

- Loss of an increase to the Territory's Gross State Product of $231 million per year;
- Loss of increased employment opportunities;
- Loss of the opportunity for increased household income and consumption;
- An earlier closure of the existing mine and refinery which would have a serious impact on the viability of the Gove community and end the current benefits received by the traditional owners;
- Loss of the opportunity to introduce process efficiencies and environmental improvements associated with new expansion technology;
- Loss of a potential anchor customer for an additional supply of natural gas to the Northern Territory; and
- Loss of the beneficial air quality and reduced Greenhouse effects from the replacement of fuel oil with natural gas.