Past, present and future for Rimu Production Station

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Abstract

In December 1999, Swift Energy New Zealand Limited discovered the Rimu field in PEP 38719 in southern Taranaki with the successful Rimu-A1 exploration well. Two years later, Swift has drilled eight wells in the area, has completed stimulation fractures on two of these wells, and is constructing a central processing facility south of Hawera. This facility, the Rimu Production Station (RPS), will be completed by mid-February 2002 and commissioned shortly thereafter.

Moving from the initial discovery to production at the RPS in only 26 months, Swift has demonstrated the flexibility, innovation, and fast-track development that are key success factors for an independent oil company's growth and success. Swift has also acted quickly to commercialise the Rimu discovery and has set stretch targets for further development in New Zealand.

This paper covers the factors that led to Swift's decision to build its first and, at that time, only oil and gas processing facility. Details of the plant configuration and design are discussed. Future development options, along with up-to-date field and infrastructure development plans, will also be presented.

Introduction

Swift Energy Company is an independent oil and gas company engaged in the exploration, development, acquisition, and operation of oil and gas properties in the United States and New Zealand. The company was founded in 1979, is headquartered in Houston, Texas, and is listed on the New York Stock Exchange and the Pacific Exchange, Inc., under the symbol SFY.

Swift Energy Company has been active in New Zealand since 1995, principally through it's 100% owned subsidiary, Swift Energy New Zealand Limited (Swift). Swift holds 100% interest in PEP38730 (North Taranaki), 20% and 7.5% interests in PEP38718 and PEP38716 respectively (Central Taranaki), and 90% interest in PEP38719 (South Taranaki). More recently, Swift has reached agreement with Shell New Zealand to acquire interests in four onshore producing oil and gas fields and infrastructure known as the TAWN assets (Reference 1).

In seven years, Swift has gone from a new entrant to a major player in New Zealand's oil and gas industry, with particular interests in the onshore Taranaki thrust belt region (Figure 1). Since the previous conference, there has been significant change in the development of PEP38719, and these are presented below.

PEP38719 activities

Beginning in 1995, Swift was successful in acquiring two exploration permits that eventually were consolidated into PEP38719. Antrim Oil & Gas, Ltd., a wholly owned subsidiary of Calgary-based Antrim Energy Inc. (Toronto: AEN), and Marabella Enterprises Ltd., a subsidiary of Brisbane-based Bligh Oil and Minerals Ltd. (Australia: BLO), each hold a 5% interest in the current permit. An exploratory well, the Rimu-A1, was drilled in December 1999 to a depth of 5,026 meters. Hydrocarbons were found at multiple levels. The well was tested in the upper Tariki sandstone and produced at rates up to 1525 barrels of 44-degree API gravity crude oil and 4.8 million cubic feet of natural gas per day with no measurable water. The test was obtained on a 32/64-inch choke with flowing tubing pressure of 1370 psi after approximately six hours of testing.

The success of the Rimu-A1 well prompted further exploration and development of the Rimu discovery and the nearby Kauri prospect. To date, a total of eight wells have been drilled in PEP38719. Details of these are provided in Table 1.

Under the current petroleum mining regulations Swift is permitted to test the wells and flare the gas for a maximum of 90 days, after which the wells are shut in. This initial test

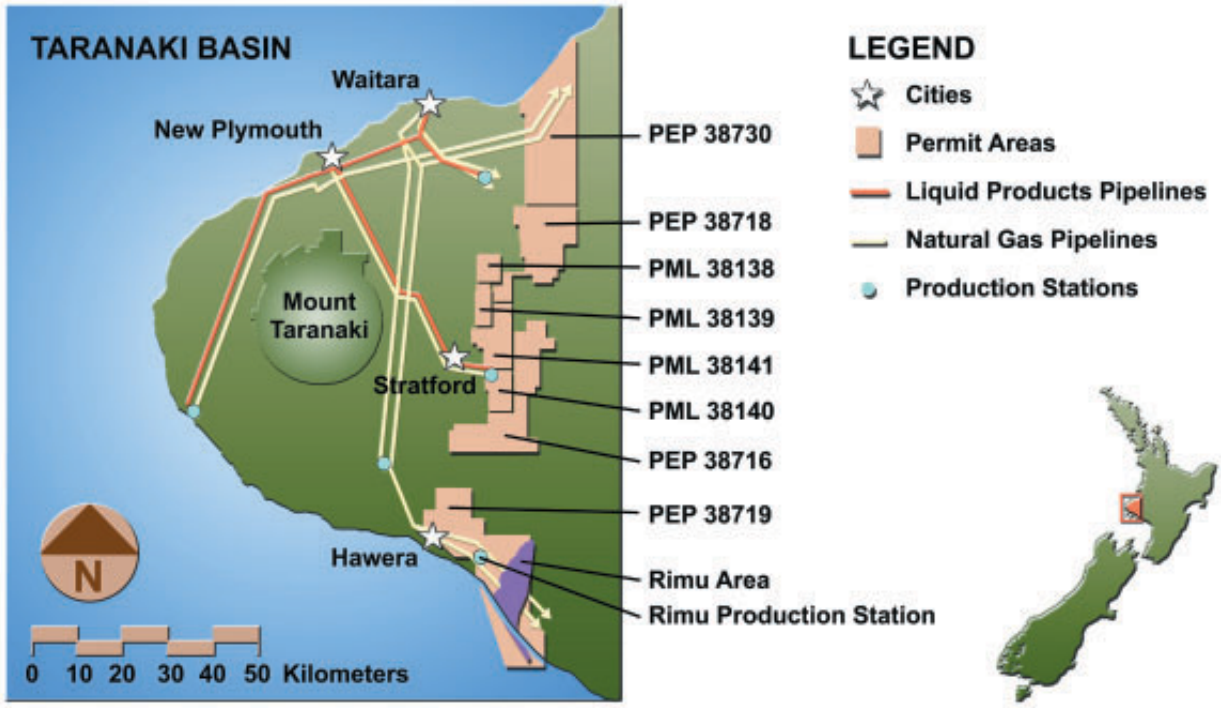

Figure 1: Swift's Current PML & PEP Interests in New Zealand

Table 1: Rimu and Kauri well summary

Well	Spud Date	Depth, TD (meters)	Status	Formation / Comments
Rimu-A1	22 July 1999	5026	Producer	Upper Tariki sandstone
Rimu-B1	18 July 2000	4350	Producer	Rimu limestone
Rimu-B2	24 October 2000	3551	Producer	Rimu limestone
Rimu-A2	26 December 2000	4696	Other	Will side track to new bottom hole location
Rimu-A3	6 March 2001	3900	Producer	Upper Tariki sandstone
Kauri-A1	3 May 2001	4500	Shut in, oil	Evaluating
Kauri-A2	7 September 2001	1280	Producer	Manutahi sands
Rimu-B3	20 September 2001	4300		

information and reservoir models were then used to predict features of the field and establish a development plan. A petroleum mining license (PML) application was filed with Crown Minerals in mid-2001 and should be issued in early 2002.

PEP38719 geology

The Rimu and Kauri fields are located in the southern Taranaki Basin predominantly onshore area west of, and associated with, reverse movement along the Taranaki Fault system.

The reservoirs and potential reservoirs (with oil and gas shows in various wells) include (from oldest to youngest): Maitai (Permian); Murihiku (Triassic); Rakopi and North Cape (Cretaceous); Mangahewa (Eocene); Rimu Limestone and Tariki Sandstone (Oligocene); Kauri Sandstone and Urenui Sandstone (Miocene) and Manutahi Sandstone (Pliocene). All of the reservoirs, except the Rimu Limestone, are sandstone reservoirs.

The Rimu field currently has two main tested reservoirs: the Rimu Limestone and Tariki Sandstone in the upper thrusted plate. The Rimu Limestone is a fractured limestone reservoir. The Tariki Sandstone reservoir, discovered in the Rimu-A1 well, is interpreted to be deposited in an outer shelf to upper continental slope environment as turbidites and channels associated with a submarine fan sequence.

The Rimu Limestone and Tariki Sandstone intervals are repeated in some of the well bores where reverse movement along the Taranaki Fault System has pushed Rimu and Tariki rocks originally deposited further east over units to the west.

In the Kauri field area production is currently from the shallow (~1100 to 1200 m) Manutahi Sandstone (Matemateaonga Formation, Pliocene). The Manutahi Sandstone was deposited in a shallow marine succession in an inner to middle shelf environment.

Testing is ongoing at the Kauri A1 well where the Kauri Sandstone (Manganui Formation) has up to 250m of net sand with oil and gas shows. We believe the Kauri Sandstone was deposited as a submarine fan sequence in an inner to middle shelf environment.

Field development and processing

The field development plan detailed in the PML proposes a total of 15 wells distributed across five pads, with well flow lines converging on a central processing facility.

Options considered for oil and gas processing were:

- purpose-built facilities
- basic separation and crude stabilisation at Rimu and building a wet gas line to either the Shell Todd/NGC plants at Kapuni or the Fletcher Challenge Energy plant at Waihapa for further processing
- full well-stream multi-phase flow lines to either Kapuni or Waihapa.

These options were discussed with the relevant parties and analysed in detail. Ultimately Swift decided on option a, which led to the building of the Rimu Production Station (RPS) at Mokoia, 8 km south east of Hawera in South Taranaki.

The key factors Swift considered in deciding to build and operate its own facilities were:

- Flexibility in field development. There was significant uncertainty over the size and optimum development path for the Rimu field at the time the decision was made. While new facilities appear to be more costly, Swift chose to maintain flexibility for future developments in and around PEP38719.
- Timing. Consenting processes and negotiations for a single plant were less time consuming than approaching multiple "affected parties" that constructing a pipeline would require. Swift had more certainty that the plant consents would be approved to meet the development schedule.
- Control. In the United States, where gas is a traded commodity, a processing company will build plants and extend gas-gathering lines to an operator's well site under competitive terms and conditions. Swift found this to not be the case in New Zealand. Instead, owners of existing processing facilities were vertically integrated in the energy industry and had other drivers. Swift believed it was in its best long-term interest to develop its own facilities and keep future development options open.

In April 2001 Swift Energy Company (Swift-US) announced that it was moving ahead with design and construction of the new facilities at Rimu (Reference 2). There is no doubt that this was the right decision. Recent changes in the New Zealand oil and gas industry and further success in our exploration program have confirmed that Rimu and Kauri are world-class discoveries and that there is significant upside potential in PEP38719.

RPS project schedule

Preliminary design for the RPS started in early 2000. Swift engaged Plant & Platform Consultants Ltd (P&P), New Plymouth, to design and build the facilities under a reimbursable Engineering, Procurement, and Construction Management (EPCM) contract. The tight schedule did not allow development of a fixed price EPCM contract. Instead, an incentive-based approach was used based on total project cost; schedule; and health, safety, and environmental performance.

Using experienced engineering personnel and minimising the need for client intervention on technical matters, P&P has been able to move quickly with completing the design and construction. A small integrated client–consultant team worked closely to address issues, to make pragmatic decisions, and to remain focused on the completion targets. To date, there has been a low level of re-work and most of the project additions are the result of new information becoming available as drilling has progressed in PEP38719.

Initial site works at the production station started in the second week of May 2001, although the longest lead items, the compressors and generators, had been ordered at the beginning of the year. Construction continued through October and December, which were the wettest months for 30 years. The facilities will be physically complete and ready for start-up in late-February 2002, after a construction period of only nine months, an extremely tight schedule for a "field-built" oil and gas plant in New Zealand.

Overall it will be 26 months from the initial oil discovery at Rimu A1 (late December 1999) until the plant is commissioned and commercial production has started. Table 2 below summarises the development time frame for other major oil and gas discoveries in New Zealand.

While there are differences in size, location, and well-stream composition in all the above developments, there is still a marked difference in the time frame for development. Onshore exploration wells currently cost around NZD 10 million. By accelerating commercial production an oil and gas company can realise additional shareholder value.

Table 2: Field development time frame

Field	Initial discovery production	Start of commercial time frame	Commercial development	Contributing factors
Kapuni	1959	1970	11 years	First major gas field, establishment of gas infrastructure
Maui	1969	1979	10 years	Offshore, large-scale development
McKee	1979	1984	5 years	Resource availability, acquisition of field and reserves information
Tariki / Ahuroa	1986	July 1996	10 years	Gas marketing
Mangahewa	1997	Sept. 2001	4 years	Gas marketing
Rimu	Dec 1999	Feb. 2002	26 months	

In the United States, the development time frame for onshore discoveries in locations with an existing oil and gas infrastructure is measured in months, not years. As New Zealand's oil and gas industry continues to mature and the energy industry becomes more competitive, Swift expects to see the same pressures for early production here.

RPS design basis

Capacity

The RPS is designed to nominally produce the following products in phase 1 (to be completed February 2002):

- 10 MMscfd sales gas to NZS 5442:1999 (approximately 4 PJ pa)
- 40 TPD (17 TPD C3, 23 TPD C4) LPG products to NZS 5435:1996
- 3500 BPD stabilised crude oil.

However, the process equipment and utility systems have all been oversized, and the plant is capable of being expanded with minimal additional capital in phase 2 to:

- 20 MMscfd sales gas
- 94 TPD LPG products
- 8250 BPD stabilised crude oil.

Existing consents restrict trucking to between 7 am to 9 pm and will effectively curtail throughput to around 6250 BPD stabilised crude oil.

As with any new facility, through optimisation of plant operating parameters and performance and through realisation of design margins, it is expected the phase 2 capacity will exceed these design criteria.

Although most of the infrastructure and utility systems (e.g. LPG storage) will support additional capacity, a third expansion phase would require the addition of a second train at the RPS.

Feed specification

Swift has been surprised by the variation in fluid properties from the wells tested to date. The initial discovery well (Rimu-A1) produced a waxy crude with properties similar to McKee crude from north Taranaki. Oil from the Rimu-B2 well, although waxy, had a lower yield, was lighter, and was more akin to a gas condensate. The Kauri-A1 and Kauri-A2 wells have produced crude with significantly different properties (Table 3).

The presence of hydrocarbons in multiple zones and the variations in well-stream properties and flowing conditions (pressure and temperature) confirm both the complex nature of the area and the need for further appraisal and delineation drilling to fully realise the potential of the permit area.

Product specifications

The export gas product is made to a "Sales Gas" quality in accordance to NZS5442:1999. The limiting specification is Wobbe Index (maximum = 52). This is achieved through removal of LPGs and the addition of inert gas.

Propane and butane products produced meet the requirements of NZS5435:1996 and are stored as segregated products. Customers can lift propane, butane, or a mixture, depending on their needs.

The total combined stabilised crude product going into tankage shall meet the criteria for shipping of:

- Reid Vapour Pressure (or RVP) of 69 kPa-abs maximum at 37.78°C
- Pour point minimum of 20 °C (achieved through dilution with condensate and pour point depressant).

Table 3: Well-stream properties

Field	Producing Zone	API Gravity	Pour Point (deg C)	Separator Gas HHV (MJ/m3)
Rimu-A1	Upper Tariki sand	43	27	55
Rimu-B2	Rimu limestone	46	27	52
Kauri-A1	Upper Tariki sand	34	+27	48.6
Kauri-A2	Manutahi sand	16	-18	46.8

Site selection

The RPS is located close to the sea approximately 90 km (55 miles) south of New Plymouth (Figure 2). In contrast to the surrounding topography, the site is relatively uniform, sloping gently towards the south. The annual rainfall for the area is 1100 mm (44 inches) with the predominant rainfall period between April and October.

Volcanic ash soil underlies the site. The soil dries quickly with a slight breeze; however, once it is saturated, carrying out earthworks in the wet is extremely difficult. Although the site lies in the highest seismic loading area in New Zealand, liquefaction during a seismic event is considered unlikely because of soil stability and the low water table.

The site is accessed via Mokoia Road, originally a single lane rural road approximately 2.5 km (1.5 miles) long. To handle the construction and production traffic (oil and LPG tankers), the road has been widened to two lanes and largely re-sealed, and the entrance from State Highway 3 has been re-worked.

Key factors in the site selection were:

- availability of flat land
- proximity to Rimu-A and Rimu-B pads
- road access
- proximity to sales gas transmission line
- location of nearest neighbors

The final site chosen balanced all these criteria and at an acceptable overall cost.

Organisation

The plant will be operated on a continuous basis, 24 hours a day with a shift crew of two. A total complement, including day support and management staff of 20, was envisioned. With the addition of the TAWN assets and the forward exploration and development program, Swift's New Zealand based staff are expected to reach 60 by the end of 2002. These skilled oil and gas professionals have been recruited from within New Zealand or attracted back to Taranaki.

Figure 2: Rimu Production Station 15 December 2001

RPS design details

Process flow

The Production Station is fed from two well sites, Rimu A and Rimu B, situated at distances of 1.7 km and 3.3 km, respectively (Figure 3). Three pipelines run from each of the Rimu-A and Rimu-B pads to the RPS. These are:

- 200-mm NB flow line
- 100-mm NB test flow line
- 50-mm NB utility gas line (for fuel and pigging operations).

Each flow line is protected from overpressure and loss of pressure by two independent acting "Barber" ESD valves. Pigging stations are provided at each well site. Due to the high pour point (+28°C) of the crude oil, the flow lines are insulated and heat traced. The 100-mm NB test flow lines are insulated and electrically heat traced over their entire length, while the 200-mm flow lines are fully insulated but heat traced only through river crossings. A well stream heater has been installed at the A pad to assist in start-up and transfer of wells between the main and test flow lines. In the event of a shutdown or prolonged stoppage, pigging with fuel gas can clear the flow lines.

At the RPS, the flow lines can be lined up to either the test or production separator. These are three-phase separators, which

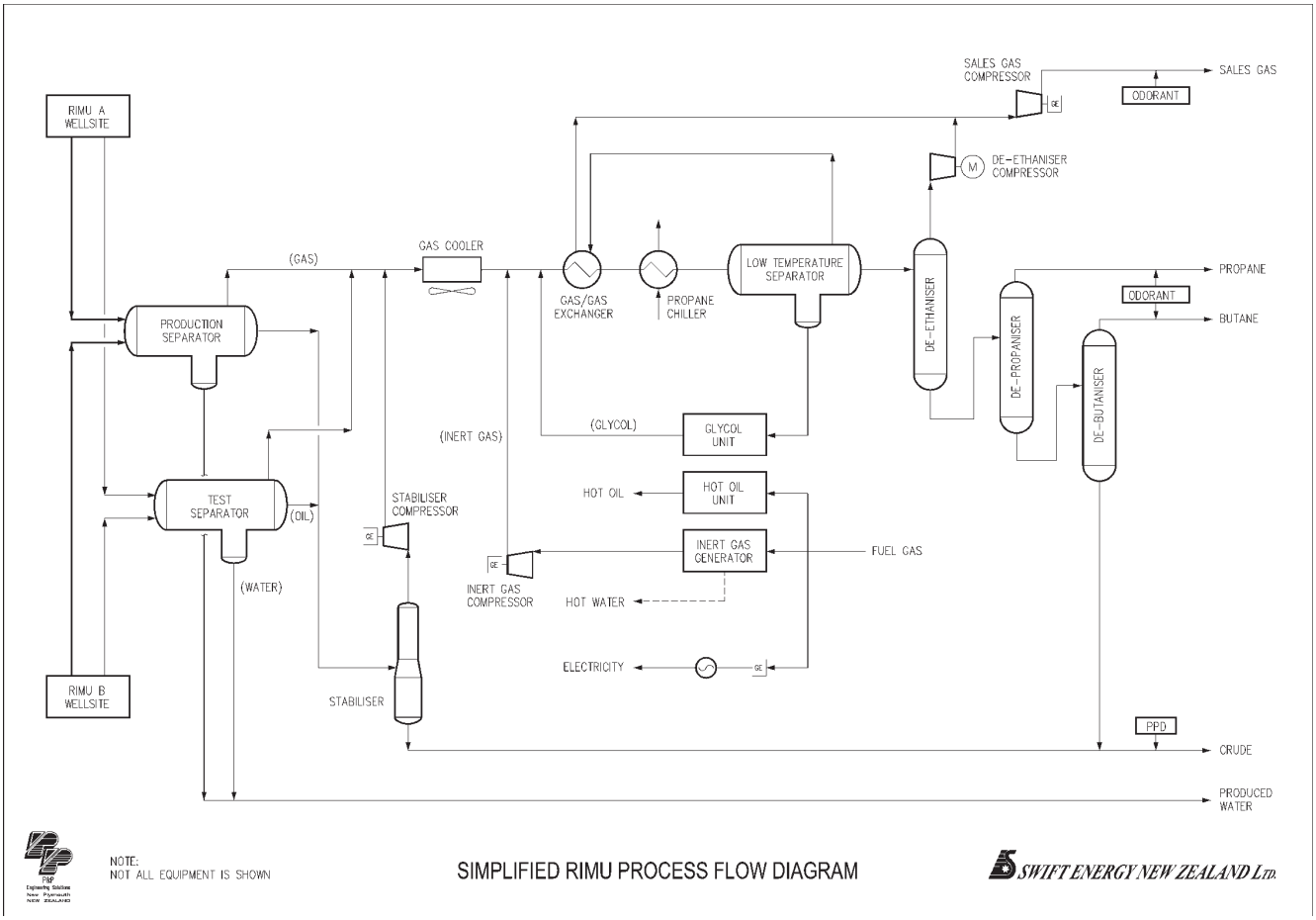

Figure 3: Rimu Production Station Process Flow

allow the separation of oil, associated gas, and produced water. Oil flows from the separators to the stabiliser. Here 'light ends' (butane, propane, ethane and some methane) are removed to ensure the crude is suitable for transportation (RVP (max) = 10 psia @ 100 deg F). Light ends from the top of the stabiliser are compressed and enter the gas plant ahead of the gas cooler.

Associated gas from the production and test separators is cooled and enters a (mostly) conventional Low Temperature Separator (LTS) gas plant. The LTS chiller uses propane refrigerant to cool the gas stream down to –15 degrees C. Natural gas liquids (NGLs) drop out in the LTS separator and the dry gas is re-heated and compressed up to pipeline pressure. This pressure is variable and ranges from 63 barg in the summer to 83 barg in the winter.

NGLs separated in the LTS separator pass to a three-tower distillation system, which produces specification propane and butane for storage and sale. Overheads from the de-ethaniser tower are re-compressed back into the sales gas stream, and natural gasoline from the bottom of the de-butaniser tower is blended back into the crude product for export.

Inert gas

Well-stream analysis of fluids for the Rimu-A1 and Rimu-B1 well streams showed a low percentage of nitrogen and carbon dioxide and high concentrations of ethane and LPGs. As a result, it was not possible to produce a sales gas that met NZS5442 without the addition of inerts. Consideration was given to blending the gas with other higher CO2 gases (e.g. Kapuni), reaction through partial combustion, or inerts generation and injection. Ultimately, low-pressure combustion for inert gas generation and compression was decided upon.

The inert gas is generated in a unit supplied by "Thomlinson" of Australia. This unit was originally developed for use in the coal mining industry and has been adapted for use at the RPS. The unit produces inert gas (nitrogen, CO2 and less than 1.5% oxygen) at low pressure. Controls and safety systems have been carefully designed to ensure that at all times there is less than 2% oxygen in the inert gas. The low-pressure inert gas at 0.1 barg is fed to a six-cylinder, five-stage reciprocating compressor, which boosts the pressure to 42 barg for injection into the raw gas inlet to the gas plant.

Waste heat from the combustion process is used to supply hot water for the site and the balance is rejected through aerial coolers.

The proposition of inert gas added is approximately 6% and is required to control the Wobbe Index of the Sales Gas.

Control systems

To maximise safety, reliability, and performance, the RPS facilities will be controlled by a "Delta V" distributed control system supplied by "Fisher Rosemount" (Reference 3). The system includes two redundant Delta V controller nodes and a separate "HIMA" node for the safety shutdown system. Together, they have a combined I/O of approximately 800, of which 65 are control loops.

SMART transmitters and valve positioners communicating via the HART protocol have been utilised instead of switches, as they can be monitored continuously for failure and can provide accurate measurement in real time.

The HIMA safety shutdown system includes the functions of emergency depressurisation, emergency shutdown and the fire and gas system. The safety shutdown system is independent from the process control system and is designed to meet the requirements IEC 61508 for safety and protective systems. The HIMA safety shutdown system is seamlessly integrated into the operator control stations to provide a "total picture" to plant operating personnel.

A semi-automated electronic load-out system provides electronic metering of both LPG and condensate load out to road tankers.

Historical data collection, trending and management information will be available through the Fisher Rosemount supplied "PI" system, which can be accessed both at the RPS and across the Swift WAN.

Electrical supply

The site is connected to the Powerco network via a single overhead 11-kV cable. This is an extension of a rural reticulation system and has required upgrading to be able to provide the required capacity. Concern over the load capacity and reliability of the system resulted in the installation of two 624-kw gas engine driven generators. These units will be base loaded to meet normal site demand and will be configured to allow export of a small surplus to the Mokoia road 11-KV power supply.

All plant motors and major power users, distribution boards, etc. are supplied directly from the motor control centres connected to the main switchboard. Minor loads, such as lighting, building services, heat trace, etc. are supplied from distribution boards located throughout the plant as required. Gas engines directly power the largest power users (e.g. compressors), and all fin fans and large motors are controlled by variable speed drives to limit electrical loads and control noise.

Firewater

Firewater is supplied at 10 barg via three diesel-driven fire pumps from a pond (min capacity 2300 m3), which collects runoff from paved areas. Spray cages are installed around the LPG storage bullets and LPG tanker load-out bays. Fire monitors are provided at strategic locations. Storm water runoff from the paved areas is collected in the firewater pond together with clean water from the API Separator. Although the site is located between the Manawapou and Tangahoe rivers, it is elevated and river water is not accessible. An artesian bore has been drilled for limited site use and firewater pond make-up.

Produced water

Produced water will be disposed of by re-injection underground. Initially the produced water will be trucked off site for disposal in other wells. Later, as the water cut increases, Swift plans to either re-use a depleted well or drill a specific well for water re-injection.

Noise control

Specialist design and careful equipment selection were required to meet the RPS site consent noise limits of 55 dB at the notional boundary to the nearest residence.

Plant layout and equipment placement required careful consideration in the early design. The major contributors to plant noise are the compressors and generators. To achieve the required noise level reduction, the compressor and generator buildings required concrete wall and roof construction fitted with attenuation panels to absorb the sound and acoustic treatment of the ventilation systems. This resulted in the buildings becoming much more costly than a conventional steel portal frame type industrial building.

Although the noise limits are similar to other recent Taranaki sites, they are significantly tighter than what Swift is used to in its US operations and have added substantial costs to the project. However, Swift recognized the need for a low-impact design as a key element in obtaining community acceptance, which would allow speedy implementation, a successful project, and long-term sustainable operation in a rural environment.

New Zealand content

When complete, Swift will have invested NZD 50 million in building and commissioning the RPS. Although a number of the larger and more complex items of equipment can only be sourced from offshore, it is important to recognize that nearly 58% of the total capital was NZ sourced and supplied. This has had a major impact on the Taranaki economy and in South Taranaki in particular.

Rimu sales contracts

Swift has previously announced gas sale and purchase agreements with Genesis for an initial "traunch" of gas (Reference 4). This amounts to 40 PJs over a 10-year period. This gas will be transported by NGC on the Kapuni to Rotowaro pipeline for use in Genesis' thermal power station at Huntley. (In reality, Rimu gas will flow to Wellington on the southern line until production rises above 10 PJ pa). As the field is developed, Swift expects to market additional gas to other customers.

An LPG sales agreement has been concluded with Natural Gas Corporation and Rockgas for the initial LPG production. The terms of this agreement are confidential.

Terminal and marketing arrangements for the oil are still being finalized, but will involve the use of some facilities at Shell's Omata Tank Farm and oil infrastructure at Westgate's Newton King terminal.

Future development plans and options

Delineation drilling in the Rimu area has confirmed the presence of hydrocarbons in multiple locations and zones. Some of the wells tested to date are at pressures below the RPS design inlet pressure. To process these streams and to maximise recovery from the field, it is clear that a low-pressure feed system will be required. Preliminary design of the additional facilities is under way, with completion expected later this year.

While it is difficult to accurately predict future developments in this industry, Swift believes there will be significant further development in South Taranaki.

Development of the shallow Kauri discovery (further south of Rimu) will likely require multiple pads with directional wells drilled from each pad. Oil and gas will be collected and fed onto the RPS for processing and transportation.

Plans are under way to drill exploratory wells in the Tawa and Matai prospects in the northern area of PEP38719 in late 2002 or early 2003. Assuming this results in commercial discoveries, gathering lines will be extended north from the RPS.

As further development drilling occurs within PEP38719, the RPS will undergo phase 2 expansion to 8,250 bpd. This will likely coincide with completion of an oil transportation line from Rimu to the Waihapa Production Station to move the larger volumes of crude to Omata Tank Farm and Port Taranaki for export.

Options for a third-stage expansion at Rimu are still being reviewed. These may include full processing at the RPS or partial processing at the RPS and expanded capabilities at Waihapa.

Completion of the oil pipeline will extend existing infrastructure to South Taranaki and establish the Waihapa and Rimu Production Stations as strategic assets for further development. Swift supports and will actively encourage third-party use of its facilities to promote further development and competition in the industry.

At some stage, the offshore Kupe field will be developed. Over the years there have been several field development studies and one of the preferred locations for landfall of oil and gas pipelines from the off shore facilities is the RPS location. Swift believes the RPS and pipeline infrastructure will play an important part in commercializing this field.

Conclusions

Since the initial Rimu discovery in December 1999, Swift has moved quickly to realise the benefits of this early success by continuing its exploration and development program and fast tracking the design, construction and commissioning of the Rimu Production Station. Continued success in the drilling program and the recent acquisition of the TAWN assets have confirmed Swift as a major player in New Zealand's onshore oil and gas industry.

The "world class" nature of the Rimu and Kauri discoveries and acquisition / development of key infrastructure assets will under pin Swift's future growth in New Zealand. In a very short time period, Swift has demonstrated the flexibility, innovation, focus and fast-track development that are key success factors for an independent oil company's growth and success.

Swift believes that New Zealand has significant untapped oil and gas potential in the Taranaki Basin, and the company intends to be a major player in the discovery, development, and production of that potential.

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