EFFECTIVE ENVIRONMENTAL DECISION MAKING IN THE PACIFIC – TAKARA GEOTHERMAL PROJECT, EFATE, VANUATU

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ABSTRACT

Small island states are concerned about their environment, their people and their economies. In recent years a geothermal electricity project has been proposed on the Takara geothermal field, Efate, Republic of Vanuatu. This 5 to 10 MW geothermal project, proposed by Australian company Geodynamics, would mesh into a diesel-dominated electricity supply system (but including some wind and biofuel with a small but growing amount of solar power) run by UNELCO centred on Port Vila. Diesel generation is expensive and is a major contributor to the very high cost of reticulated electricity in Vanuatu generally and on Efate in particular. The geothermal project would reduce dependency on imported diesel and may lower electricity price, leading to higher connection rates. Existing Vanuatu environmental law and regulations are based around submission and approval of Environmental Impact Assessments (EIAs) and Environmental Management and Monitoring Plans (EMMPs) by the proponent to the Director of the Department of Environmental Protection and Conservation (DEPC). The Takara project was the most technically complex report the DEPC has seen to date. This led to the establishment of a Review Committee, supported by a technical advisory team, and including involvement of New Zealand-based geothermal experts. While the proponent funded the overall process, some financial support was provided from the New Zealand Government. The project exploration phase was approved by the Review Committee in January 2015 conditional on a modified EMMP, within the legislated timeframes. This was the first time that a Review Committee had agreed a procedure in consultation with the proponent for assessing a project, and had undertaken its own consultation. The process for environmental review and approval of complex projects now has a precedent that could be useful as the Government of Vanuatu overcomes damage by the recent cyclone and seeks to further develop its national infrastructure.

1. BACKGROUND

Vanuatu is a small Pacific archipelago nation. Historically the islands of what were called the New Hebrides in colonial times were jointly administered by France and Great Britain until independence was achieved as the Republic of Vanuatu in 1980. The most densely populated island is Efate on which the capital, Port Vila, is situated. The Melanesian people are known as Ni-Vanuatu. The 230,000 population actively use over 110 languages making this the highest language density of any country in the world, though English and French are used in government and business circles and the national language of Bislama is widely understood.

Rural society is still based around hereditary chiefs who have a strong influence over their people. Land is effectively under the chief's control, although there may be an individual's name against the title. Ownership and title to land are frequently sources of dispute, for which some resolution can come through the Council of Chiefs.

As a small island nation, Vanuatu faces similar challenges to other island nations with the economy focused on agriculture and tourism. Relative isolation means that fuel costs are high, and this flows through to the cost of electricity since this is largely diesel-based or diesel-indexed. For comparison, an average New Zealand house would pay seven times the annual cost for electricity if relocated to Port Vila. The cost of electricity has flow-through effects on connection rates then further economic development and at domestic level on lighting and then education. As such, the Government of Vanuatu has sought means to reduce dependency on fossil fuels and to reduce the cost of electricity. Part of the solution may lie with the development of geothermal power on the island of Efate.

For the major islands, the Government has licenced the generation, distribution and retail of electricity to utility service companies. A large French company, UNELCO, (a wholly-owned subsidiary of GDF Suez) has operated the electricity concession licence for Port Vila for many years. It is interesting to note that UNELCO is now active in New Zealand as part of a district heating consortium as part of the Christchurch rebuild. Port Vila and environs actually covers much of the island of Efate, so UNELCO has recently been extending its distribution network along a newly upgraded island ring road to bring in new housing developments while enabling connection of villages along the way. Despite this, across Vanuatu only 27% of people have access to electricity, while on Efate only 76% are connected.

To meet Efate's electricity demand which currently peaks at around 11MW, UNELCO's generation portfolio includes:

- Several diesel gensets, the largest of which are located at the Tagabe power station west of Port Vila,
- The Devil's Point wind farm (11 x 275 kW machines) also west of Port Vila,
- A growing pool of photovoltaic generation, and

- Copra oil-fired generation. One of the 4MW units at Tagabe has been converted to run on copra oil. In turn the copra oil is sourced from Cofely, a subsidiary of UNELCO, which has coconut plantations, a copra mill and contractual arrangements with suppliers of copra and copra oil around Vanuatu. Clearly there will be flowon benefits across Vanuatu from the supply of this renewable energy.

Any external developer of geothermal power will need to negotiate a supply arrangement with this regulated monopoly. The Government of Vanuatu has established the Utility Regulatory Authority to help manage monopoly power, and a URA staff member attended the Geothermal Institute in 2014 to build up their expertise in readiness for geothermal development.

Figure 1 shows typical load curves through the year for Efate. A 4 MW copra oil supply could supply much of the mid-year demand. Alternatively, it can be seen that baseload demand is about 4 MW.

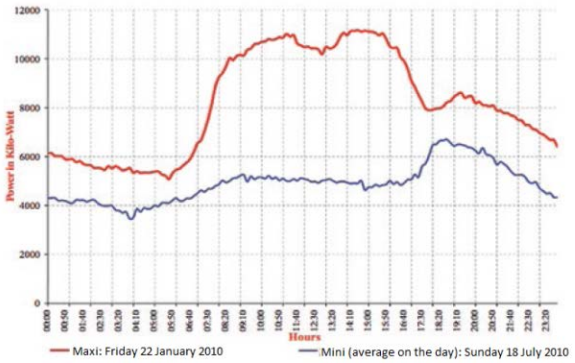

Figure 1: Minimum and maximum day system load curves for Efate (from UNELCO Annual Technical Report 2010 as presented in the National Energy Road Map)

2. THE TAKARA GEOTHERMAL RESOURCE AND ITS CURRENT USE

Vanuatu is volcanically and seismically active. Consequently geothermal surface features are present and have been known, though are not spectacular. In the 1970's and 1980's (following independence), the New Zealand Government offered assistance in terms of assessing Vanuatu's geothermal resources. These and more recent surveys undertaken for KUTh Energy by what is now Jacobs has led to a focus on the Takara geothermal field on the north side of Efate.

Originally KUTh had 3 prospecting licences as shown in Figure 2 covering Takara, Epule (east of Takara) and Teouma (south of Takara) but two licences were allowed to expire in April 2013, while the Takara prospecting licence was extended until October 2013 and subsequently changed to a production licence. Within the Takara prospect area there are three target zones. These are known as A – Mt Fatmalapa, B – Central and C – Takara. All attention is on the Takara Zone, but the proximity of the backup Central Zone gives confidence that a station built in the Takara zone could be fully loaded with fluid if the station is oversized for the Takara Zone.

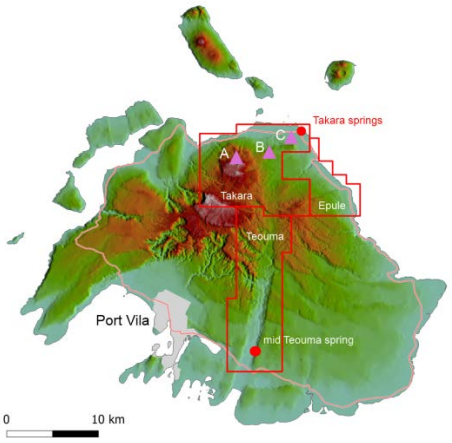

Figure 2: Original KUTh prospecting licence areas (from KUTh's Statement of Estimated Resources)

The estimated potential output from the field is shown in Table 1.

Table 1: Estimated power plant capacity (KUTh, 2010)

Target Zone	Estimated Power Plant Capacity (MWe)		
	P10	P50	P90
A - Mt Fatmalapa	75	43	15
B – Central (Taspua)	37	22	7.4
C - Takara	28	18	9.6
Total Mean Value	83 MWe		

While prospecting its areas, KUTh funded sampling of springs and water bores, which indicate the nature of reservoir fluids, and commissioned fresh magneto-telluric resistivity studies which can indicate information about the depth and size of the reservoir. The resource is coastal with some springs just offshore within the reef and clear influence of tides on the major springs onshore. Seawater dominates the chemistry of the springs which disguises the chemistry of the deep reservoir fluids making inferences about reservoir temperatures more difficult. Best estimates of temperature from this are that the reservoir may be between 140 and 190^{o}C which is easily sufficient for binary cycle generation. Seawater may also be affecting interpretation of resistivity measurements.

The field takes its name from the area and from the adjacent fishing and farming village of Takara Landing. The area had been developed during the Second World War as a US airforce base so has extensive areas of flat runway space for development. Some shallow temperature gradient and water supply wells have been drilled in the area, with gradient wells at the west end of the runway having reported maximum temperatures of around 80^{o}C, while a water well drilled in the same vicinity some years ago was reported to have experienced a hydrothermal eruption. It is only since the consenting process described later in the paper that it was discovered that the Civil Aviation Authority was interested in occasional use of the runway as an alternative to the main Bauerfield Airport for emergency landings.

At Takara, the land owners have undertaken limited direct use developments of the geothermal resource. The

following photos are of the Nasinu Pools which are an overflow from a sulphur spring about 500m further west on the coast. Despite the length of open drain pool temperatures are still a little over 40^{o}C, and pools have been made available to tourists for use at 500 vatu per visit (NZ$7). There are various bathing pools and channels, but a need for cash injection to lift it to international tourist standards. Mud is meant to have healing properties and the water if gargled is meant to cure mouth ulcers.

Figure 3: Photos of Nasinu Pools including the channel that leads from the natural springs

In addition to this, some mildly steaming ground near the WWII US airstrip has been used for copra drying (for on-sale to Cofely), and occasionally for a local form of vegetarian hangi.

There was a dispute over land ownership in the area. Four different parties have been claiming ownership rights linked to ancient roots, or historic and recent settlement for agricultural purposes.

3. ROLE OF KUTH AND GEODYNAMICS

KUTh Energy was the original proposer of this geothermal project. KUTh Energy merged with Geodynamics Ltd in 2014 and undertook subsequent work in the name of Geodynamics. These were both Australian Stock Exchange-listed companies, and Geodynamics continues as a publicly listed energy company, currently diversifying into solar energy.

The KUTh (and now Geodynamics) concept is for an initial 4 MW net development, eventually doubling in size once load has grown. An alternative concept used by KUTh to seek funding called for an 8 MW development with load-following capability. The project would be connected to the Port Vila load through a 33 kV distribution line ringing the Efate island coast, assumed to be installed by UNELCO. Water supplies would come from the Epule area for drilling purposes. Reinjection would be practiced for the full development although some discharge test fluid may be discharged to sea beyond the reef.

KUTh secured prospecting then production licences, and paid for supplementary science and concept development. The World Bank funded Castlerock Consulting to undertake a feasibility study for the Government of Vanuatu being finalised in January 2012. KUTh started negotiation of a Power Purchase Agreement with UNELCO with a view to securing funding from external parties, though this has been left at a framework stage.

Being aware of the dispute over land ownership, they surveyed the local population, which determined that many local people saw the potential project as beneficial. Consequently, they continued to work closely with claimants and with Government of Vanuatu so that the project can proceed and eventually the right parties can be compensated. The Government of Vanuatu has been encouraging resolution through the Council of Chiefs.

In terms of environmental permits, initially KUTh obtained a view that, because of the low impact of exploration, an Environmental Impact Assessment would not be required for the exploration drilling. All parties had second thoughts about this. Geodynamics, after its merger with KUTh, subsequently commissioned an EIA for the full development to be used in seeking consents for the exploration drilling. The consenting process is the subject of the rest of this paper.

Having secured exploration environmental permits, Geodynamics is continuing to seek funding on international markets, both for exploration and for the full development.

It should be noted that cyclone Pam followed the securing of exploration permits, and that much Government attention has been refocussed on recovery since then. Geodynamics was able to demonstrate good neighbourliness to the Takara community which being on the north of the island faced the full force of cyclone Pam. Following the cyclone, Geodynamics provided temporary roof coverings for the many damaged buildings.

4. THE CONSENTING PROCESS

The consenting process for the Takara project was helped by the existence of a legislative and regulatory framework, and the willingness of all parties to work for an acceptable quality outcome.

The process was governed by Vanuatu's Environmental Protection and Conservation Act 2002 (CAP 283) and the associated Environmental Impact Assessment Regulations (Order No 175 of 2011, as amended). However there was a degree of flexibility built into these documents that enabled a structuring to account for the complexity of the Takara project.

External New Zealand geothermal expertise was facilitated by the New Zealand Ministry of Foreign Affairs and Trade. This entailed linking up two experienced New Zealand geothermal experts to work in close collaboration with the key government agencies. Stephen Daysh, an experienced New Zealand environmental expert with wide geothermal experience assisted with the preparation of Terms of Reference and sat as one of the Decision Makers on the Environmental Impact Assessment (EIA) Review Committee. The second expert, geothermal engineer Brian White assisted with the technical aspects of the process including assistance with the Terms of Reference and led a Technical Advisory Team which provided advice to the EIA Review Committee.

After discussions with Geodynamics, the Director of the Department of Environmental Protection and Conservation set out the following consultative path within the Act and Regulatory framework:

March 2014 – Terms of Reference for the EIA were issued by the Department outlining a 2-phase process initially focussed on exploration to be followed by development activity.

September 2014 – Draft EIA report ready for public consultation. In practice, Geodynamics prepared an EIA which covered all aspects of the project through to final implementation so communities could consider everything in their discussions. This was important as geothermal development is largely new to Vanuatu citizens.

October 2014 – Geodynamics undertook public consultation. This process involved minuted site meetings with communities, information sheets, radio and TV advertising about the project, availability of the EIA and associated Environmental Management and Monitoring Plan (EMMP) and opportunities for written submissions.

October 2014, the Technical Advisory Team was established and prepared comments on the draft EIA and EMMP for the Director and Geodynamics.

November 2014 – Geodynamics submitted the Final EIA and EMMP, along with draft EIA Consultation and Submissions report, a detailed spreadsheet providing responses to submissions and questions raised at meetings, and a supplementary technical memorandum about water supplies. They also confirmed that they were satisfied with approvals limited to the exploration phase.

December 2014 – the Acting Director (there had been a high level staff change) appointed members of the EIA Review Committee.

January 2015 – Further public consultation was facilitated by the Department to help close off the process (in terms of community feedback) started by Geodynamics. The EIA Review Committee was expanded by one person to bring in the views of Government aviation interests. Final approval decision for the exploration work was given by the Acting Director based on the EIA Review Committee report and recommendation at the end of January 2015.

As can be seen, the environmental assessment and decision making process was focused and was achieved in a 9 month timeframe. This compares favourably with timeframes for other consenting processes, which in some jurisdictions can take several years. The process featured a good level of working interaction between the proponent, government agencies and the community, as the information was compiled and assessed. As the Review Committee worked through the detail of their final decision, they engaged in further discussions with Geodynamics to avoid misunderstandings and to ensure workable and effective conditions were within the EIA Review Committee's redrafted EMMP.

5. SOME LESSONS LEARNT

5.1 Scope of the EIA

The Terms of Reference required Geodynamics to prepare its EIA in two phases – firstly around the exploration phase and secondly associated with the development phase. This was because the potential environmental and community impacts of exploration drilling were a narrow subset of potential environmental community impacts associated with a full development. This phasing also recognised current knowledge of the field was limited, so there would be a high degree of conjecture about the nature of fluids, and how best to develop the field and manage impacts before exploration drilling occurred.

In practice Geodynamics' prepared an EIA and EMMP for the whole development. There were some positive aspects of this broad assessment as this will be the first geothermal development in Vanuatu and the population had many questions and some concerns about what the overall development might mean which were able to be addressed in the comprehensive EIA and in the consultation process.

However, the documentation did leave many parties confused about what Geodynamics were immediately proposing and seeking approval for from the EIA Review Committee. This meant the EIA Review Committee needed to clarify with the Takara and surrounding communities that only exploration drilling and testing work would be considered for approval initially.

5.2 Civil Aviation Concerns

Geodynamics' plan for Takara is tightly focused around use of the old World War 2 airstrip for some production well pads and for the power station site. The airstrip was regarded by most parties as abandoned, and the initial consultation during the preparation of the EIA then publically through October did not raise particular flags. Subsequently the Technical Advisory Team discovered that Civil Aviation authorities were considering Takara airstrip as an emergency landing alternative to Bauerfield. As a consequence, the Acting Director invited civil aviation authorities to appoint a member to the EIA Review Committee so that views could be adequately represented.

In its final decision, the Review Committee recognised that weighing the public good value of geothermal power versus backup air safety strategies was a political decision to be made by Ministers, and the final exploration approval from the EIA Review Committee recognises this position.

5.3 The Environmental Management and Monitoring Plan (EMMP)

The Act and Regulations set out the requirements of an EIA and a separate EMMP. For all intents and purposes, the EMMP sets out the detailed conditions of consents in terms of management of risks and effects, and monitoring of possible impacts. The opportunity is there for the proponent to draft and propose conditions for their project, which is good practice.

As part of their documentation Geodynamics had prepared an EMMP within their EIA, however this covered a wide range of activities and impacts outside exploration activities. In addition, some relevant management tasks were included in EIA tables or in the text of the EIA, but not in the EMMP. As part of its deliberations the EIA Review Committee and their advisors prepared conditions in the form of an exploration-specific EMMP. A draft of these revisions was discussed with, and input received from Geodynamics, prior to the EIA Review Committee's final decision being made in January 2015.

5.4 Public Consultation

Geodynamics did undertake thorough consultation in preparing their EIA. With such projects there is an obligation on the public to use information available and for affected parties to enter discussions. However, during the EIA Review Committee phase some additional issues were found which were able to be addressed by the Committee. An example of this was the emergency landing option where the relevant parties had not been aware of the different plans for the same area, until a late stage.

Some of the public meetings had involved collection of community concerns, which were then addressed by Geodynamics in spreadsheets sent to the EIA Review Committee. However, the communities that had raised these concerns, and still had them, contended they had not had adequate "face to face" feedback with the developer. Thus, when the Review Committee went to site they faced a wide range of questions and issues. This was useful as final conditions and the EMMP could be tailored to address relevant concerns raised. In hindsight, though, it would have been better if Geodynamics had also been present in Vanuatu for the review process and associated meetings with the community.

Geodynamics will need to have ongoing consultation with the relevant communities as this project progresses.

5.5 Land Ownership

There are some land ownership disputes at Takara and the government has been attempting to get resolution of these in a timely manner.

Geodynamics has set out public strategies for compensation of appropriate parties when the issue is resolved, and has set out a Community Benefits Programme as part of their development strategy. In practice it is considered this is another area requiring Ministerial guidance and resolution. The EIA Review Committee report and decision recommendation recognised that these matters are outside the scope of the Act and EIA Regulations so the EIA Review Committee had no role or authority to determine these matters. It could only comment that Geodynamics would need to secure appropriate land arrangements before they could proceed.

6. FINAL OUTCOME

On the 7th of January 2015, the EIA Review Committee recommended to the Acting Director of the Department of Environmental Protection and Conservation that he should approve the application by Geodynamics Ltd to drill two geothermal exploration wells – on the condition that the EMMP which the Review Committee had drafted was implemented and complied with. After due consideration, this decision was made by the Acting Director and was passed to Geodynamics later in the month of January.

Geodynamics has 12 months of the date of approval to substantially commence their efforts.

8. CONCLUSIONS

The following conclusions can be made:

1. The Takara Geothermal Field on the island of Efate Republic of Vanuatu could have an important future role in the positive economic development of the country, through harnessing it as a renewable source of electricity;

2. Initial resource investigations indicate that a 5 to 10MW geothermal project could be developed which would reduce the dependence on Efate's diesel-dominated electricity supply system;

3. Australian and New Zealand geothermal expertise has assisted with investigating and assessing the Takara resource, with the Australian based company Geodynamics holding a development license and an exploration approval under the Republic of Vanuatu environmental legislation, with New Zealand geothermal expertise providing environmental and technical assistance to government officials in the decision making process;

4. The Republic of Vanuatu environmental legislation includes clear provisions and processes for environmental assessment and effective decision making, including the setting of agreed Terms of Reference to ensure the scope of investigations and consultation is fit for purpose along with an interactive Decision Making Framework. The Takara environmental assessment and decision making process was focused and was achieved in a 9 month timeframe (which included the period for the proponent to both research and report on environmental impacts and proposed management and monitoring strategies). This compares favourably with timeframes for other consenting processes, which in some jurisdictions can take several years;

5. Geodynamics undertook a thorough environmental assessment (EIA) and consultation programme for the project covering the full exploration and development phases. However, in hindsight it is considered it would have been more effective if they had prepared this information in the two distinct phases as set out in the EIA Terms of Reference. This is because it proved difficult for the community and EIA Review Committee to focus on the initial exploration permit aspect of the project given that the EIA and associated EMMP documentation was not well tuned to the exploration activities and environmental and

community impacts which were the subject of the initial approvals;

6. It is recognised that land ownership issues and securing development funding remain significant challenges for the Takara Geothermal project, but the granting of the exploration environmental permits through a robust and thorough process is considered an important milestone to help facilitate these next steps;

7. Experience from the exploration consenting phase of the Takara geothermal project provides a useful example which could be utilised for other infrastructure development projects in the Republic of Vanuatu and also for other countries looking for effective decision making processes to permit the use of geothermal resources in an environmentally sustainable way.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the cooperation of officers and Ministers of the Government of Vanuatu throughout this process. The New Zealand Government through the Ministry of Foreign Affairs and Trade has provided funding for some preparatory work. Geodynamics has funded the EIA development and review process.

We recognise the ongoing interest of the people of Vanuatu in this project and look forward to a final realisation of the benefits – "to energise Vanuatu's growth and development through the provision of secure, affordable, widely accessible, high quality, clean energy services for an Educated, Healthy and Wealthy nation" (National Energy Roadmap 2013-2020).

REFERENCES

Castlerock Consulting, *Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework, Final Report.* Prepared for World Bank Group (18 January 2012)

KUTh Energy, *Statement of Estimated Geothermal Resources Takara Geothermal Project, Vanuatu* (5 October 2010)

Republic of Vanuatu, *Vanuatu National Energy Road Map 2013-2020* (March 2013)

Republic of Vanuatu Department of Environmental Protection and Conservation, *Terms of Reference for the Takara Geothermal Project Environmental Impact Assessment (EIA); March 2014.*

Republic of Vanuatu Department of Environmental Protection and Conservation, *EIA Review Committee Report and Decision Recommendation relating to the Takara Geothermal Project Exploration Phase; January 2015.*