Solar SETuP Case Study – Rollout of Tranche One Medium Contribution Sites

September 2019

PowerWater

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List of acronyms

ARENA – Australian Renewable Energy Agency
CEMP – Construction Environment Management Plan
EPC – Engineer Procure Construct
ESO – Essential Services Operator
FAT – Factory Acceptance Test
HMI – Human Machine Interface
IES – Indigenous Essential Services
HV – High Voltage
kV – Kilovolts
kW – Kilowatt
LD – Liquidated Damages
LTU – Land Tenure Unit
LV – Low voltage
MW – Megawatts
NTP – Notice to Proceed
OPGW – Optical Ground Wire
PC – Practical Completion
PCC – Point of Common Coupling
PV – Photovoltaic
SAT – Site Acceptance Tests
SCADA – Supervisory Control and Data Acquisition
SETuP – Solar Energy Transformation Program

Acknowledgement

This project was supported by the Australian Government through the Australian Renewable Energy Agency (ARENA). ARENA was established by the Australian Government on 1 July 2012 to improve the competitiveness of renewable energy technologies and increase the supply of renewable energy in Australia. The agency's expertise, deep understanding of the renewable energy sector and willingness to fund innovative and groundbreaking projects means it provides a pathway to commercialisation for many new technologies and businesses. ARENA also shares knowledge, insights and data from funded projects to help the renewable energy industry and other projects learn from each other's experiences. More information is available at www.arena.gov.au.

Introduction

This document describes the approach taken and learnings from the first 10 solar arrays delivered by Power and Water Corporation (Power and Water) through the Solar Energy Transformation Program (SETuP). These 10 sites are collectively referred to as Tranche One. This report is part of the program's knowledge sharing activities, forming a key deliverable under the program's funding agreement with the Australian Renewable Energy Agency (ARENA).

This document focuses on the communities where SETuP was delivered during Tranche One – Areyonga, Amunturangu (Mt Liebig), Arlparra, Kaltukatjara (Docker River), Kintore, Lajamanu, Maningrida, Nyirripi (Waite Creek), Ramingining and Yuendumu.

Tranche One was the first component of SETuP's overall medium contribution rollout that saw installation of nine megawatts (MW) of solar capacity integrated into 24 diesel power stations servicing remote Aboriginal communities throughout the Northern Territory.

The medium contribution deployment goal was to achieve a peak power penetration of 60 per cent, which is the equivalent of 15 per cent annual diesel energy saving across all sites. The rollout looked at the maximum economic amount of solar energy that could be utilised without incurring the cost of storage or other supporting technologies.

The program aimed to see solar embedded into the Power and Water standard power station design and to transition from being a 'novel' technology to one that was part of the normal 'business-as-usual' operational model. The solar rollout aimed to result in an updated Asset Management Strategy that incorporated solar in any calculation for the future fuel storage and diesel engine capacity requirements.

For more background on the project, please refer to Appendix A.

SETuP array at Kaltukatjara (Docker River).

Project design principles

The fundamental approach of the medium penetration component of SETuP was to build utility owned and operated flat plate photovoltaic solar arrays that work in unison with the existing diesel power station in each community, without requiring batteries or other supporting infrastructure. This approach was based on Power and Water's 20 years of experience with solar technologies in remote communities. The scope for the SETuP program was exclusively remote Aboriginal communities managed under the Indigenous Essential Services (IES) program.

The operating and design principles that underpin SETuP are explained in more detail in the Solar/Diesel Mini Grid Handbook available from the Power and Water website at www.powerwater.com.au

In brief, the SETuP solar arrays were specified with a PV controller at each site to enable the output of solar inverters to be directly managed by the power station control system. The PV controller provides control over the maximum output to ensure system stability, and to ensure adequate load is maintained on the existing diesel engines to avoid damage from extended low load operation.

A key design philosophy was to build free-standing, ground mounted arrays on dedicated leases, rather than attempting to utilise roof space or unused third party land in communities.

A further important design decision was to specify the use of flat plate photovoltaic technology while allowing the market to identify which technology would be most cost effective.

Technical and economic modelling was conducted to determine the size (kilowatt [kW] capacity) of the array that would be optimal for each community, taking into account system loads, landed diesel prices and the existing diesel engine characteristics.

With no existing land available for the purpose, land needed to be obtained as part of the SETuP program in the form of leases. The size of lease required for each community was dictated by the desire to minimise shading from surrounding obstacles and by the larger space required for thin film technologies. Once land was obtained, the site could then be cleared, fenced, interconnected and a solar array built and commissioned.

The overall approach to the project was to minimise changes at each power station, retaining the existing engines and keeping and modifying the existing control systems. It was important for Power and Water to maintain ownership of the power station control system, so it was not locked into one vendor.

In order to meet data collection and monitoring requirements, all sites needed to have a robust backhaul data connection from the power station to Power and Water's internal supervisory control and data acquisition (SCADA) network. A reliable high speed data connection from the solar array compound to the power station at each community was also required for real time control and to support extensive data collection from the solar facility.

The key concept of Power and Water's overall approach to the project was not to be completely prescriptive, so that design as well as constructing the solar arrays could be outsourced as an Engineer Procure Construct (EPC) contract using a multi-stage tendering process. This provided the tenderers with some flexibility for innovation and cost savings.

Power and Water retained responsibility for all of the site preparation works, including community engagement, land acquisition, geo-technical assessment, clearing and fencing. Power and Water also designed and managed the electrical and data connections to the power network Point of Common Coupling (PCC) at each site. This reduced risk for the construction phase for the EPC contractor.

Providing smaller contracts for the site preparation activities also allowed smaller local contractors to be involved in the project.

Power and Water recognise the importance of effective engagement with the Aboriginal people living on the land. Community engagement was started early in the project and continued throughout the program to maximise opportunities for Aboriginal employment and local development.

Project signage at Maningrida.

Power and Water component

Community engagement

Communicating the benefits of the SETuP program, as well as construction realities and renewable outcomes, required a different approach to standard marketing and stakeholder engagement.

The broad aims of the community engagement program were to:

- deliver engagement plan outcomes through community visits
- engage with the broad sweep of community stakeholders
- increase community education, awareness and support for the project.

Once resources were developed, community visits, including 'event days' were planned and undertaken. Initially, this work was carried out by contracted engagement consultants, however as the program progressed, Power and Water staff took carriage of the engagement activities.

Challenges for using external engagement consultants included lack of consistency in resourcing the engagement program for the life of the project. While moving the community engagement in-house may be cost effective and easier to resource if suitably qualified staff are available, it may also result in an increased work load on busy staff.

Adopting an individualised approach can be time consuming and resource intensive, although using local networks, such as the Local Authority and job service providers, is an effective way to deliver messaging and seek feedback. Local Authorities represent a range of community stakeholders, often including local Traditional Owners, job service providers and local retailers. This wide representation of stakeholders adds further value to any presentations on the project to the Local Authority.

Community posters in Ramingining

Lessons learnt

- Use culturally appropriate tools with pictures, graphics and photos to meaningfully convey messages to remote communities as English is not the first language spoken
- Test communication tools with community stakeholders to check if they are culturally appropriate before distributing
- Outsourcing community engagement support requires selecting experienced partners who are committed to maintaining key personnel for longer contracts
- Request detailed curriculum vitae of the consultants committed to the project to help decision making and approval of any changes to key personnel is recommended, particularly for longer projects
- Use regionally-specific community engagement contractors for topics that require additional focus
- Be strategic about providing effective engagement with internal staff through shorter, targeted visits
- Internal staff require adequate support for engagement activities

- Liaise with the local job service provider to notify them of the project schedule and garner local interest to achieve greater local Aboriginal engagement outcomes
- While assessing suitable land for tenure, the leasing process usually proceeded with less iteration at sites where SETuP staff held on-site consultations with the community
- Face-to-face opportunities, such as the local authority forums and other community meetings, were a highly effective communication method.

CASE STUDY

Consulting with the Maningrida community

Maningrida solar compound open day..

Community engagement was a significant feature of SETuP. At Maningrida this included several events to inform the community of the project, technology, and benefits to the community and included community information sessions and site visits to the solar array by local school students.

The Chief Minister also dropped in to one of the community events. These events proved to be very valuable in educating the community about the benefits of solar energy. A solar demonstration kit with a small solar panel and 'generator' was used at the event to demonstrate the continuous power supply to a small fan while the panel was producing power in the sunlight, and then when it was moved to the shade.

Land acquisition

The Tranche One rollout included constructing solar arrays on Aboriginal freehold land.

The process of acquiring leases over the necessary parcels of land required different approaches depending on the status of the lease. If there was no existing lease, a lease was sought directly from a land council. If there was an existing township lease, a sublease was applied for via the Office of Township Leasing (OTL).

The power for leasing such land is found in Section 19 of the *Aboriginal Land Rights (Northern Territory) Act 1976*.

To acquire the leases, SETuP and IES worked in collaboration with the Northern Territory Government's Land Tenure Unit (LTU), which is part of the Department of Local Government, Housing and Community Development. The LTU is the central clearing house for all Northern Territory Government leasing and allows a single point of contact with land councils and the OTL.

Identify suitable sites

Criteria for selection of land included:

- being close to the power station or to the existing 11 kilovolts (kV) distribution network
- flat land with minimal rock and undulations
- road access, aesthetics and dust mitigation
- whether there was a security buffer zone between the lease and road
- avoiding existing water bore 'wellhead protection zones'.

Potential solar sites were first identified using Power and Water's in-house geographical information system which allowed aerial imagery of sites to be overlaid with basic cadastral, infrastructure and topographical information. Another overlay of 'Restricted Work Areas' identified areas of likely cultural sensitivity, which helped to identify suitable site locations before formal application. Following site identification, stakeholders within Remote Operations were consulted to ensure the land area was suitable for the use (e.g. not flood prone).

Apply for lease

Each lease application required supporting documents, including a current Aboriginal Areas Protection Authority (AAPA) certificate, or Sacred Sites Clearance Certificate (SSCC) for Central Land Council areas, Power and Water approval regarding essential services and a variety of visual material, including maps.

The Section 19 land use agreement process gives Traditional Owners the opportunity to consider, develop terms and conditions, and the right to consent to or reject proposals on their land. Relevant land councils are the only entities with the legal capacity to carry out consultations and negotiations on behalf of Traditional Owners with organisations that are interested in carrying out commercial or infrastructure activities on Aboriginal land.

Through the land councils, Traditional Owners were given the opportunity to make an informed decision in accordance with their traditional decision making processes. Affected Aboriginal people and communities were also given an opportunity to express their views in relation to land use proposals. SETuP staff participated in on-site consultations when invited to do so, and were able to respond to questions about the 'what, where, when and why' of SETuP.

Sacred site clearance/Aboriginal Areas Protection Authority

The AAPA Certificate and SSCC process aim to provide surety for the Traditional Owners that land or objects of cultural significance are protected from inappropriate development and land use.

Lessons learnt

- Early community consultation helped the optimum site to be selected
- Due to complexities with acquiring land, some sites may not be utilised, so additional communities need to be considered to enable the program to be flexible with site locations.

Land studies

Glare assessment

As part of choosing suitable locations for solar arrays, a glare assessment was undertaken if the location of the solar array was within 500 metres of an airfield or a flight path. If there is a risk of glare impacting pilots, the Civil Aviation Safety Authority has the power to order the solar arrays to be removed.

Professional consultants were engaged to conduct the glare assessments to make sure there were no impacts on pilots flying near or over the solar arrays.

Geo-technical investigations

To de-risk the site construction phase, geo-technical studies were prepared by Power and Water to inform the EPC of the sub-surface conditions and allow for design of the foundations, earthing and lightning protection systems.

Construction Environment Management Plan (CEMP)

To encourage local operators to bid for the civil works in preparation for the EPC contractor, environmental consultants with local knowledge were engaged to develop CEMPs for each site. The CEMP included a Weed Management and Erosion and Sediment Control Plan. These plans were implemented by the successful tenderer with Power and Water ensuring compliance.

Lessons learnt

- Professional glare assessments are recommended to de-risk the project
- Soil resistivity and aggressivity were added to the geo-technical engineers' scope after early feedback from several EPC contractors
- Local knowledge as well as suitable qualifications are required for comprehensive environmental plans to be developed.

CASE STUDY

Sedimentation and erosion control

Maningrida solar array during a tropical storm.

Developing the Maningrida site provided valuable lessons in sedimentation and erosion control measures, for example using mulch from site vegetation clearing in berms, which was applied at subsequent SETuP sites.

Fencing and clearing

Civil works for Tranche One comprised of minimal levelling, grubbing, grading fire breaks, removing surface rocks and fencing the sites. These works were separately packaged with the CEMP to provide an opportunity for locally-based organisations to become involved. As a result, shire councils and Aboriginal development organisations successfully delivered portions of this work. The civil works were completed prior to the solar EPC contractor obtaining possession of the site.

On some sites separate contractors provided the clearing and fencing. The contracts were back-to-back with limited contingency for any lost time, so subsequent machinery failures resulted in works being delayed. This caused the fencing contractor to demobilise and remobilise, which incurred additional costs to the project.

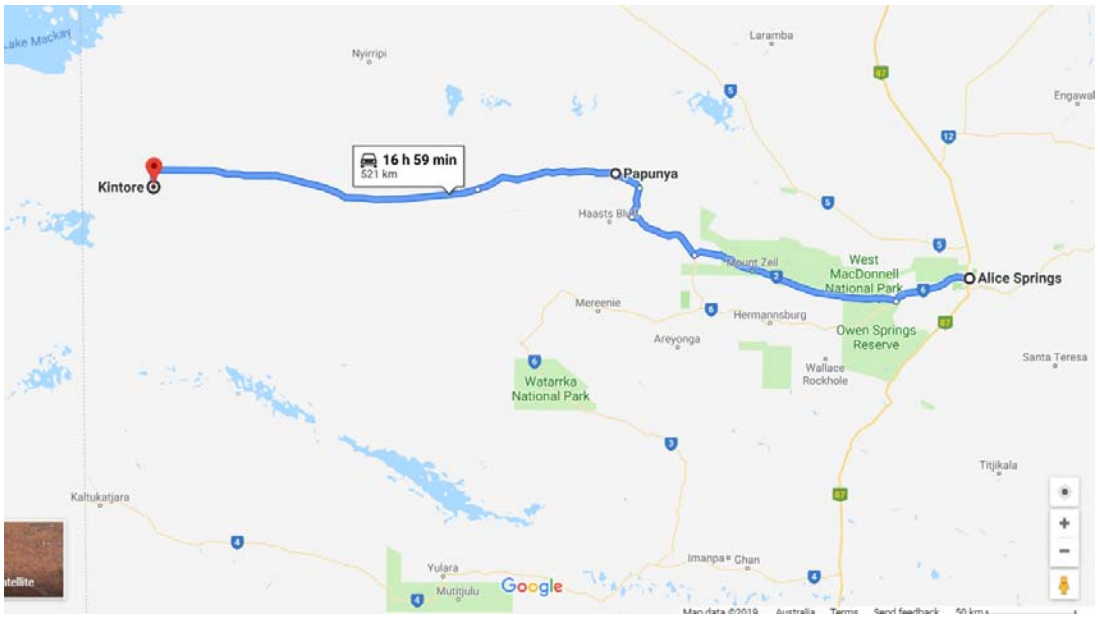
On the first sites cleared in the southern region, the intent was to leave natural ground cover in an effort to reduce the potential for erosion. Subsequent inspection by the successful EPC determined that the amount of clearing meant the sites were not fit for purpose to install the screw piles.

Lessons learnt

- Issue separate contracts for clearing and fencing, but only if adequate float can be built into the schedule
- Ensure the clearing and fencing specifications are clear at the start of the project.

Mt Liebig – all vegetation removed.

Mt Liebig – natural ground cover retained.



Travel distance to Kintore

CASE STUDY
Aboriginal employment in Maningrida

Djelk Rangers at the Maningrida Solar Site conducting weed surveys.

Before clearing and fencing took place, the local Djelk Rangers performed base line weed surveys of the Maningrida site and closely monitored weed hygiene of the contractors by inspecting construction machinery and equipment as it was mobilised to site.

The EPC contractor was able to engage local Aboriginal people, who worked on the Maningrida project to install the foundations and array frames. One of these locals continued work with the EPC contractor on the next two SETuP sites.

Site interconnection

Electrical interconnection

Power and Water used existing Panel Contracts for the electrical connections in the power station main switchboards up to, and including, the PCC. If the solar facility was directly adjacent to the power station, low voltage interconnections could be used, however, in most cases the solar facilities were connected directly to the high voltage (HV) network to minimise energy losses.

Data interconnection

Similarly, Power and Water used local contractors to supply and install the communications infrastructure from the power station to the solar facility and for the satellite link to the regional centres in Darwin, Alice Springs and Katherine.

Power and Water used optic fibre connection wherever possible, but when distance or retro-fitting was cost prohibitive, Power and Water used a licensed radio telemetry system. The optic fibre was typically an optical ground wire (OPGW) and was the preferred method due to higher reliability.

Engineer Procure Construct (EPC) component

EPC pre-qualification and site grouping

The approach for the Engineer Procure Construct (EPC) of the solar arrays was designed as a two-step process.

The intent was to issue multiple tenders for sites bundled into tranches as leased sites became progressively available.

An expression of interest stage was used to establish a shortlist of pre-vetted EPC tenderers. In parallel, a shortlist of pre-qualified components was created, covering solar modules, inverters and photovoltaic (PV) controllers.

This structure aimed to maximise economies of scale associated with purchasing equipment, and ensuring equipment and design was standardised across all sites. It also minimised future operation and maintenance costs, while providing a single point of contact for warranties and support.

This process gave the EPC contractor flexibility to plan the program of works and schedule for construction to suit resources and variables, such as weather conditions and logistics.

Tender outcome for Tranche One

Once the first 10 leases were in hand, Power and Water tendered a fixed price, lump sum EPC contract for the design, construction and commissioning of the total PV systems across 10 medium penetration roll out sites.

Nominated sub-contractors

The contract documents required the EPC to nominate sub-contractors to be used in the project delivery. However, no mechanism was in place to enforce this. During Tranche One the EPC dropped a nominated subcontractor and this in turn may have resulted in the electrical designs being delayed.

Lessons learnt

- The use of a prequalification list of EPC tenderers may not achieve the results intended in a program that is delivered over several years as company structures and pre-qualification criteria may change over time.
- Ensure mechanisms that guarantee companies alert Power and Water of any structural changes if they are pre-qualified.
- In the event that a company's structure has changed, offer opportunity for the company to remain on the pre-qualified list.
- Explore options for the contract to require the EPC contractor to obtain approval for changes of nominated subcontractors.

Functional specification and design

Specified components vs design flexibility

Power and Water developed a design/output specification for the tender according to Australian standards and establishing best practice, without being unnecessarily prescriptive.

Prescribed items included use of the pre-qualified component list, solar panels and inverters, to ensure a 25 year operational life with minimum maintenance costs.

The function specification required the EPC contractor to provide a main switchboard and to also connect through to a Power and Water supplied PCC. Providing a Power and Water PCC and requiring the EPC contractor to provide their own switchboards provided flexibility as well as allowing for an additional metering point for potential future sale of the asset.

Design outcomes and innovations

STP25000 inverter and SMA Cluster Controller

Tranche One EPC contractor's design used SMA STP25000 inverters and SMA cluster controllers. After successful proof of operation in Tranche One, Power and Water stipulated these items for subsequent EPC tenders, which ensured consistency across the tranches.

Tranche One arrays consist of 315W DC polycrystalline PV panels. Inverters are distributed and mounted under the solar panels for shading. Each inverter is connected to four strings consisting of 20 panels per string, with a combined peak output of 25 kW AC.

Cat 6 Ethernet cables in a 'daisy chain' topology are used for communications between inverters and the SMA Cluster Controller.

A typical SETuP inverter installation.

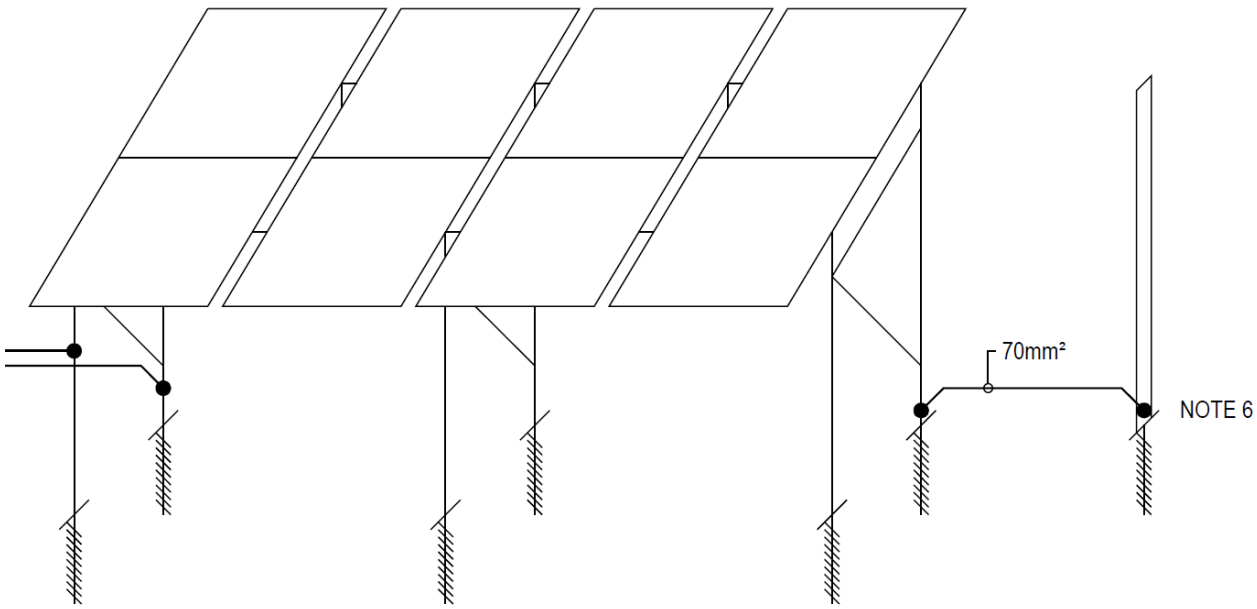
The framing system used in Tranche One was easy to erect and overall a good system.

Minimum kW size of sites

The preparation and EPC costs per kW were higher on smaller sites due to mobilisation costs, and in general it was more cost effective to build larger sites.

Earthing system using screw piles

A design innovation that came out of the EPC contract saw galvanised screw piles used as a dual function. The piles provide the foundations for the racking system and are used as earth stakes, the multiple earth stakes negated the need for a traditional earth grading ring.



Screw piles provide earthing function.

Lessons learnt

- Ensure formal punch list is established as part of the Factory Acceptance Test (FAT)
- In future programs the PCC and LV switchboard requirements may be combined into one unit by simplifying the design
- Upgrade the LV switchboard specifications from painted mild steel to stainless steel in line with remote operations' standard specification for coastal areas
- Amend the requirements for the emergency stop on the PCC to be an open button to avoid safety concerns for the emergency stop functionality
- Increase the minimum array size from 50 kW to 100 kW
- Ensure anodised framing systems have an effective method to achieve electrical continuity.

Main switchboard during commissioning in Arlparra.

EPC construction and logistics

Heat management strategies

Shade structures were made available with cold water close to the construction activities, safety hats with wide brims were issued to all workers.

Experienced site managers closely observed workers for any early signs of heat exhaustion. Lunch was provided in air conditioned facilities, however it was noted that most of the workers chose to have lunch outside in the shade.

Remote accommodation availability suitability

Contractors allocated a full time logistics manager/project administrator to coordinate accommodation bookings, which were impacted by project delays.

The accommodation needs to be clean and good quality meals provided to create good morale for the crew and avoid lost time requiring the construction crew to take on cooking and cleaning.

Local employment opportunities

It is Northern Territory Government policy to maximise opportunities for Aboriginal employment. Aboriginal participation was a selection criterion applied to the assessment of all tender responses.

Alternative ways to maximise local engagement included ensuring use of local subcontractors and stores to support local enterprises, rather than employing locals directly.

CASE STUDY

Cultural awareness training

Cultural awareness training was considered important to ensure the construction teams worked within the expected norms of the community.

Cultural awareness training was particularly important in Maningrida, which was the first SETuP site to be constructed and formed a benchmark for later works.

On-site cultural awareness training was provided to ensure that EPC staff were equipped with the knowledge and understanding required to work appropriately in Aboriginal communities. The training included being introduced to a number of key local people.

Feedback from EPC contractor Territoria Civil was positive, allowing them a better understanding of social relationships that may affect work attendance and performance, such as traditional cultural avoidance relationships.

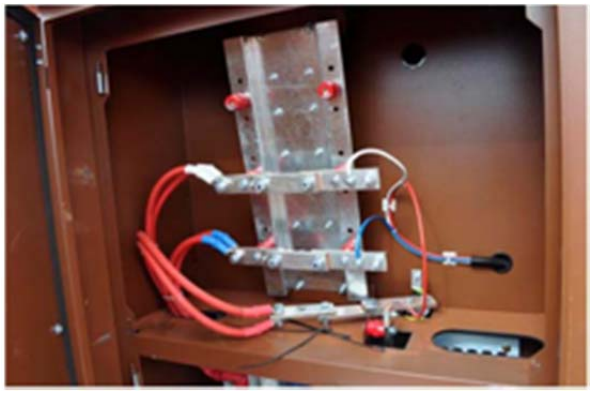
Logistics

A full time logistics manager/project administrator is required to sort out container packing and set up at the holding yard as well as rostering, flights and accommodation.

With heavy rains causing delays in the program, time was lost in sequencing sites around road closures, which required some back tracking. Transporting containers and materials to the community was not an issue, but moving them around proved difficult once they were on-site.

Transit damage

There were several instances of damage to equipment due to extremely remote locations and the conditions of access roads.



Examples of transit damage.

Communications technology

Each crew had a satellite phone, but data could not be sent by this method (fax/email) and the phone operation was unfamiliar. In some communities, the availability of the Power and Water landline phone and fax at the power stations meant that the crew was not completely without communications.

Programming the cluster controller in preparation for the Site Acceptance Tests (SAT) was difficult when there was no mobile service coverage in a remote community.

Major services and breakdowns

Major services and breakdowns impacted the effectiveness of the piling rig used by the EPC contractor for screw installation.

Forecasting the maintenance schedule to coincide with trips back to major cities could improve maintenance turnaround times. This allows the EPC contractor to source new parts once a part or the spare was broken or damaged so that a spare was available, avoiding potential delays of two or more weeks to order in a replacement part while running the risk of further breakdowns or delays.

Split crews

The EPC contractor split crews into civil and piling, framing and panels, and electrical teams. This improved efficiency for the teams as they didn't have to rely on other teams finishing work before the next team started. This flexibility meant less down time for personnel and plant.

Lessons learnt

Mobilisation of workforce

Extra management is required to arrange on-site accommodation and catering logistics due to the very limited availability of accommodation and facility staff in site communities. Some lessons learnt through delivering the Tranche One projects included:

- A pre-crew of two workers of the civil team have to arrive earlier on a rotation to clean accommodation to avoid time lost by a whole crew cleaning.
- Investigate whether good quality pre-prepared meals are available locally before organising for a crew roster for cooking and meal preparation.
- Employ heat management strategies to improve the wellbeing of construction workers.
- Look at services that could be provided locally, including meals from local stores or other sources, shops for goods, local accommodation and rubbish collection.
- In general, ensuring there was quality accommodation and catering was vital for the morale of crew and workforce retention.

Local employment

- Conduct a workshop to discuss Aboriginal local engagement issues and brainstorm ideas on how to achieve better outcomes.
- Explore the option that Power and Water employ apprentices and 'free issue' the labour to the EPC, thus building Power and Water capacity.
- Liaise with the local Job Service Provider to notify them of the schedule and garner local interest to achieve greater Aboriginal local engagement outcomes.

Logistics and transport

- Ensure there is enough resourcing for logistics and project administration to organise container packing, rosters, accommodation and flights.
- Ensure there is a level of contingency for spare materials, equipment and tools for construction to account for any damages during transit or site errors.
- Improve packaging techniques, including:
    - pre-purchase smaller storage containers and pack them logically to reduce double handling and having to return hire containers back to Darwin.
    - arrange all parts and materials to be available and in holding yards ready for packing into containers ready for each site.
- Design, select and strengthen equipment to be resilient to remote transport conditions.
- Ensure feedback to manufacturers and logistic providers.

Communications, major services and breakdowns

- Be prepared for sites without mobile network coverage and look for alternative internet and phone access options including use of landlines and satellite enabled equipment.
- Use a dedicated piling rig rather than general purpose plant (e.g. excavator) for installing screw piles.
- Carry at least one spare of all parts of the rig along with appropriate tools, and consider having a diesel fitter on-site to avoid lengthy down time.

Splitting crews

- Splitting crews enabled the EPC to work on multiple sites at one time so they could work continuously and quicker, rather than stopping and starting to work on separate sites.
- Smaller teams meant less pressure on accommodation in remote communities.
- However, splitting the crews resulted in more mobilisations, more movements between sites, more supervision and more detailed roster logistics.

Contract operation

Practical completion

Multiple practical completion (PC) dates with associated Liquidated Damages (LD) may be more complex than required to achieve contractual compliance within the schedule.

Rather than tying damages to completion of each site it is recommended as part of the program to link instead to an overall percentage completion of kW of capacity. This provides flexibility for the contractor and reduces risk while still ensuring steady progress.

Notice to proceed

The contract allowed for multiple Notices to Proceed (NTP) to be issued with the end date for PC linked to the date the NTP is issued. This did not result in a clear end date for the contract and the learning was to give the EPC contractor an overall end date to complete all of the capacity.

Lessons learnt

- Explore options that progress payments may be applied for by the EPC on completion of site works and that PC is granted on successful completion of the SAT, triggering the defects liability period for that site.
- A firm completion date regardless of the NTP date needs to be specified in the contract documentation.

Screw pile installation at Maningrida.

Operations and maintenance

In the first year of operation for the Tranche One medium penetration roll out, there were 10 SETuP sites in operation. The final Tranche One system sizes and dates of commencement are listed below, with 3325kW of capacity installed in total:

COMMUNITY	DC KW CAPACITY	DATE PRODUCTION COMMENCED
Maningrida	806.4	3 February 2017
Ramingining	504.0	17 February 2017
Yuendumu	504.0	30 March 2017
Lajamanu	403.2	21 April 2017
Kaltukatjara (Docker River)	100.8	4 May 2017
Kintore	226.8	18 May 2017
Arlparra	453.6	1 June 2017
Areyonga	100.8	23 June 2017
Amunturangu (Mt Liebig)	50.4	26 July 2017
Nyirripi	201.6	31 July 2017

In 12 months of operation from July 2017 to July 2018 the combined sites were within the overall design target of 15 per cent diesel savings. In that first year of operation there was a very low incidence of vandalism and very few early failures of equipment.

System loads and engine sizes had changed in some communities since the initial modelling was carried out, resulting in some of the Tranche One arrays being smaller or larger than the optimal size for that community.

Implementation of low load rated diesel engines helped maximise the use of available solar energy from Tranche One sites. The minimum load settings for other engines were reviewed and reduced where possible, also providing more opportunity for solar contribution.

Essential Services Officers (ESO) are contract workers based in each IES community and their role is to monitor the day-to-day operation of water, wastewater and electrical generation. ESOs are crucial links in the successful operation and 'buy-in' of solar as it becomes 'business as usual'.

The ESO's were present during the construction and involved in commissioning the systems. On-site training was conducted to ensure the ESO's were confident to operate the system. Power and Water's Electrical Coordinators conducted information training sessions to familiarise the ESOs with the project. The Electrical Coordinators oversee remote operations and maintenance and are the ESO's first point of contact in the event of an anomaly that requires technical expertise.

Regular inspection of the solar compound and assets was added to the contracted ESO duties, as was an allowance for periodic maintenance of fire breaks and regrowth within the compounds.

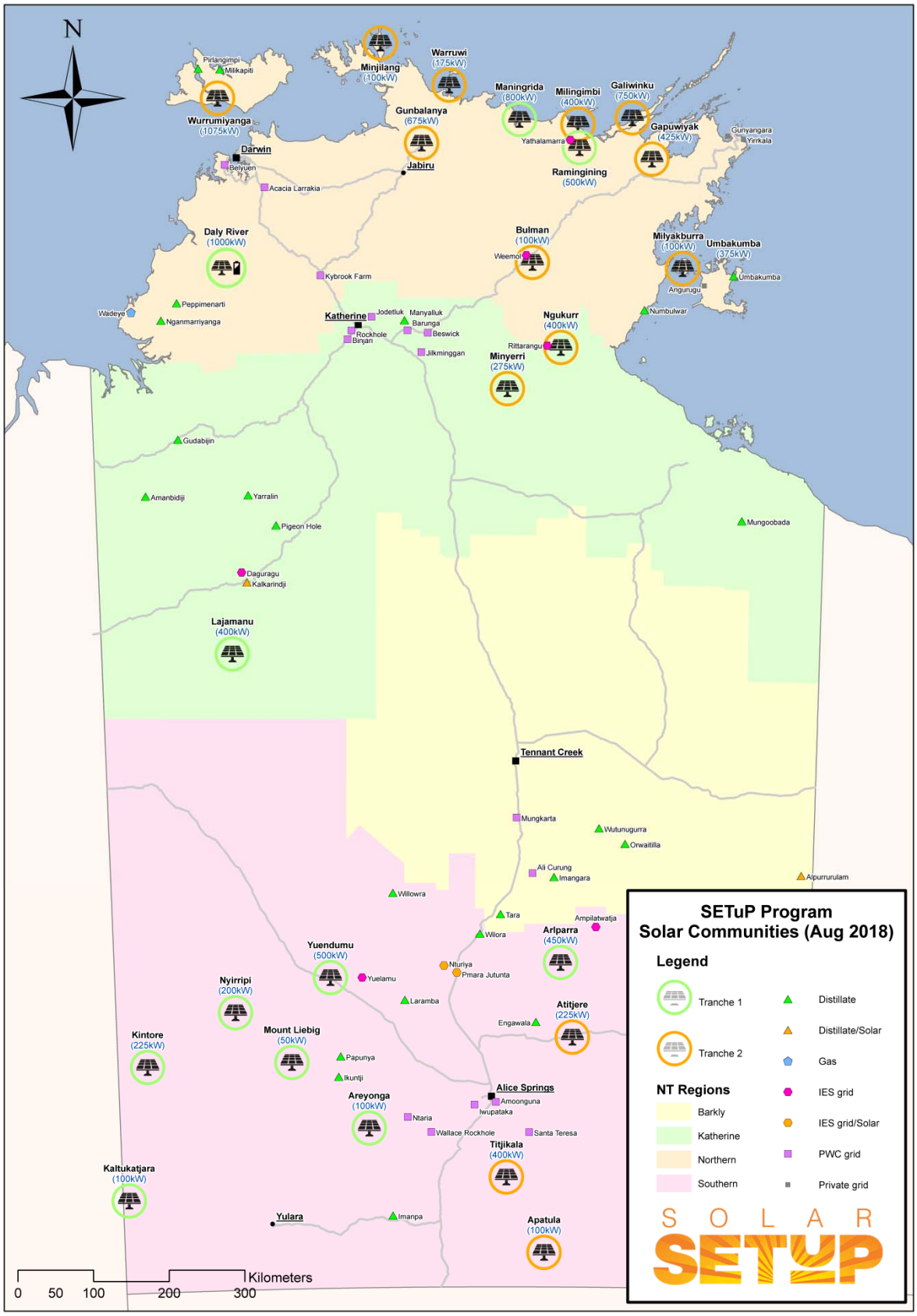
No annual cleaning of the solar modules was scheduled. A condition based approach was planned to be used in the future, supported by analysis of data from the 'atonometrics' irradiance measurement device installed at each site and general detailed data collection.

Lessons learnt

- Operational experience with the new assets built confidence in the technology.
- Recognition of the foregone value of the solar energy being curtailed (spilled) in order to maintain default engine settings provided motivation for operational staff to revisit engine minimum loading limits.
- ESOs and key Power and Water operational staff were not always available in the community at the time of commissioning, so it was necessary to allow for repeat visits or for people to attend training at other sites.
- Solar compound maintenance needed to be established on a per-site basis, taking into account available plant and equipment, regrowth rates and site-specific erosion control.

Appendix A

SETuP locations



Background

SETuP is an important demonstration project for ARENA's off-grid portfolio, providing a unique example of a fleet wide roll-out of hybrid renewable energy micro-grids, demonstrating the impact of medium penetration renewable energy on diesel consumption and costs at fleet scale. While some of this information is already available, the breadth of data from 25 dispersed sites will allow significant investigation into system optimisation.

Of more importance are the organisational changes required to shift Power and Water's Regions and Remote business unit decision making processes, asset management and maintenance regimes to integrate renewable energy into the business. The lessons on how organisational change can occur will be valuable for organisations that are attempting to embed more renewable energy into micro-grids and remote area power supply.

Ultimately the model SETuP delivers will be a blue print for future off-grid power station conversions, demonstrating successful integrations of renewable energy with diesel technologies.

The ARENA outcomes for the program were:

- Deploying medium and high penetration renewable energy systems in a diverse range of remote communities across the Northern Territory
- Building the institutional capacity and incentives of Power and Water to operate, maintain and expand renewable energy solutions as a mainstream business practice
- Generate and share knowledge that will assist other remote community energy providers to deploy renewable energy solutions.

The project knowledge sharing objectives were:

- Improved understanding of the cost of solar system construction in remote areas and the risks, challenges and benefits in undertaking a wide-scale deployment
- Improved understanding of the performance characteristics of solar-diesel hybrid systems across a large number of sites
- Improved understanding of the operation and maintenance requirements of solar-diesel hybrid systems across a large number of sites
- Improved understanding of the development pathway for achieving higher levels of solar penetrations in remote solar-diesel mini grids.

Indigenous Essential Services (IES) is responsible for delivering energy to 72 remote communities in the Northern Territory (refer to map below).

The Northern Territory Government subsidises the cost of energy so people and businesses in these remote communities pay the same price as those in urban centres like Darwin. This comes at a significant cost to government, with delivered diesel being the largest cost. In reducing reliance on diesel, SETuP provides a hedge against rising diesel prices rather than directly reducing costs to consumers.

ARENA's support for this project was provided to ensure that the learnings, insights and experience gained are shared as widely as possible.

Outcome

The full scope of the SETuP program was completed in early 2019, and resulted in a majority of communities serviced by Power and Water having hybrid solar diesel power stations. This transformation will be the future model of electricity generation for remote sites.

The upgraded power station control systems allow for integration of enabling technologies such as cloud forecasting and energy storage systems as these technologies are proven reliable and cost effective.