SOLARRESERVE®

Attention: ElectraNet
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30 January 2017

SOLARRESERVE'S RESPONSE TO ELECTRANET'S PROJECT SPECIFICATION CONSULTATION REPORT (PSCR)

Dear Sir or Madam:

Thank you for the opportunity to provide feedback to the ElectraNet's Project Specification Consultation Report (PSCR) as part of the Regulatory Investment Test – Transmission (RIT-T) process. It is with pleasure that we can provide the following information on non-network solutions that should be considered as part of your process. As detailed in this submission, we believe that a concentrated solar power (CSP) with storage solution can achieve the objectives of the PSCR at a lower net cost than the new interconnector options being considered.

Introduction

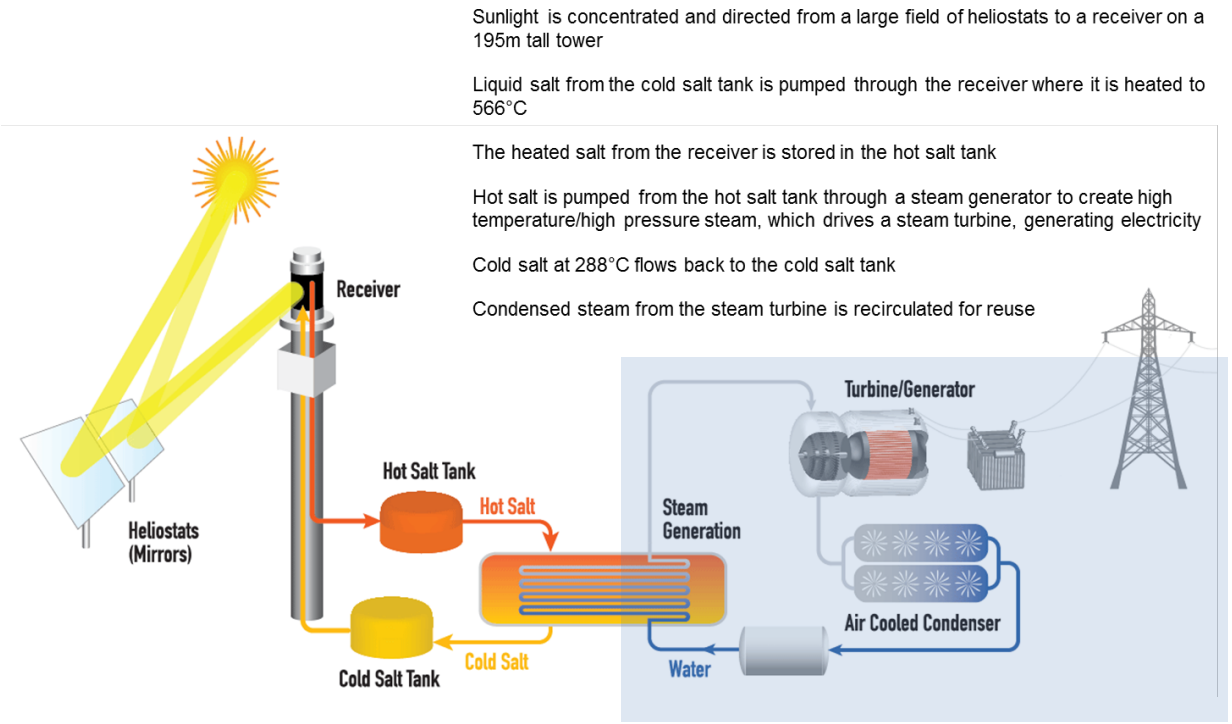
SolarReserve is a leading developer of CSP and photovoltaic (PV) solutions, combining our proprietary molten salt power tower storage technology with project development, financing, and operating expertise. Our technology can provide firm, fully dispatchable, non-intermittent renewable energy, day and night. Its power generation capabilities are nearly identical to that which is found in a coal or natural gas-fired power station.

SolarReserve has successfully financed and constructed more than US$1.8 billion of large scale solar projects worldwide. These include the 110 MW Crescent Dunes CSP project in Nevada; the 150 MW_{DC} combined Letsatsi and Lesedi Solar PV Projects; and the 96 MW_{DC} Jasper Solar PV Project in South Africa, all fully operational. Construction is due to commence shortly on the 100MW Redstone CSP project in South Africa.

Crescent Dunes Solar Energy Project, Nevada, USA. 110MW with 10 hours of full load storage (1,100MWh)

The Technology

SolarReserve's CSP with storage technology utilises molten salt to collect and store heat from sunlight during the day and then power a conventional steam turbine whenever electricity is needed. Low-cost thermal storage allows the facility to deliver clean energy at full output 24 hours a day, or whenever it is needed by the grid, rather than being subject to the moment-by-moment variability of sunshine or wind. CSP with molten salt storage can be configured to a variety of load profiles, including peaker or baseload operations.



Schematic of SolarReserve's CSP with storage technology

The power block within the facility, as presented in the blue shaded area above, is nearly identical to that found in a coal-fired power station. The key difference with SolarReserve's CSP technology is the absence of fossil fuel. Our technology relies instead on energy collected from the sun, stored in molten salt and converted to steam through a heat exchanger.

The 110 MW Crescent Dunes Solar Energy Project located near Tonopah, Nevada is SolarReserve's flagship CSP project which utilises our exclusive molten salt solar power tower technology. The Crescent Dunes Project is the largest molten salt power tower project in the world, generating over 500,000 MWh annually and providing electricity to approximately 75,000 homes during peak periods. The project's 1,100 MWh storage capability is almost 40 times the size of the largest battery storage project in construction or built to date globally. Commissioning of the Crescent Dunes Project was completed in the Q4 of 2015. The electricity generated is contracted to the utility NV Energy under a 25-year power purchase agreement. Details can be found at http://www.solarreserve.com/en/global-projects/csp/crescent-dunes

Transition from Coal to Renewables

CSP with molten salt energy storage enables the transition from fossil fuel to renewable energy based generation. The storage element of the technology enables CSP to provide nearly identical dispatchability, energy security, network strengthening and wholesale price stability to that which traditional coal-fired power stations provide, but wholly from a renewable energy resource. Being fully dispatchable, the technology can provide an alternative to network augmentation solutions such as the new-interconnectors being contemplated by the RIT-T.

Australia's commitment to the 2016 Paris Agreement will require Australia to decarbonise its electricity generation before 2050, requiring a profound change to the portfolio of the National Electricity Market. The penetration of intermittent renewable generation is expected to increase rapidly in the coming years, but as higher levels of intermittent renewable energy penetration are achieved it will require other low carbon generation technologies in the system to provide dispatchable electricity and the ancillary services essential for maintaining a high quality, reliable and secure energy system. This dispatchability is currently provided by coal-fired power stations and gas turbines which will increasingly be required to exit the market. As the market dynamics change and traditional fossil fueled generation technologies exit, CSP can fill the gap left behind to provide dispatchability, ancillary services and energy security.

The Value of CSP with Storage

Our technology delivers multiple value streams which are increasingly important in the changing energy landscape. CSP with storage provides an alternative to traditional network augmentation solutions, enhancing energy security by providing energy locally from an indigenous generation solution. The benefits that are provided by CSP can be divided into the following four categories:

- **Energy and Capacity Value**. Molten salt storage allows a CSP facility to shift energy generation to match the highest-value times on the grid. With enough storage, this shift includes covering both the typical "peak" period, and also the unexpected event of a price spike at another time, whether morning, evening, or overnight. This shifting ability allows CSP to replace conventional infrastructure not only for energy supply but for reliable capacity supply, meaning it can fully replace baseload generators like coal power plants. Storage enables CSP to operate at a high capacity factor which leads to a higher utilisation of transmission infrastructure, reducing the capital and environmental cost of building new transmission lines and interconnectors. Because CSP can operate reliably and stably, it reduces the fuel use and Operations and Maintenance (O&M) impact of flexing the conventional generation fleet in response to intermittent solar and wind conditions. And, when comparing molten salt to battery storage, it is important to note that CSP suffers no "round trip losses" when energy is stored – rather, molten salt storage is a one-way trip from sun to receiver to storage to steam. Round trip losses generally have a hidden environmental cost which is rarely considered. There is no carbon impact of storing solar energy in molten salt. For all of the above reasons, the energy and capacity provided by CSP with storage is of high value.

- **Ancillary Services.** The dispatchability afforded by molten salt storage allows a CSP plant to deliver ancillary services to the grid. "Ancillary services" include the various functions a plant can provide a wholesale market which enhance the market operator's ability to maintain stability. For instance, the practice by which a plant operates at partial capacity but turns up to full capacity rapidly in response to variations in load and generation is often called "spinning reserve." SolarReserve's CSP with storage is capable of providing frequency regulation, spinning reserve, non-spinning reserve, load following services, and black start capability. Each of these is important to the reliable functioning of the grid.

- **Intrinsic Stability**. A steam turbine, a massive piece of machinery spinning at thousands of RPM, provides significant inertia to the grid. It resists short-term fluctuations which would otherwise cascade into a brownout or blackout. CSP with storage offers fault ride-through capability, frequency response, and voltage / VAR support. These attributes are of enormous value to the grid, particularly a grid like South Australia's which has a high penetration of intermittent renewables such as wind, and where even a momentary disruption could have severe economic consequences.

- **Risk Management**. Renewable energy technology is a hedge against future electricity price increases (as it has no fuel cost), but CSP with storage is also a hedge against other risks. Because it provides ancillary services rather than requiring them from the grid, it is a hedge against future ancillary service costs. Because it enhances the stability of the grid rather than degrading it, CSP is a hedge against the future cost of integrating a high penetration of renewables into the grid – a cost which today is typically socialised in the cost of expensive transmission upgrades and

interconnectors and the implementation of higher reserve margins. The output of an individual CSP plant is also lower-risk than PV's due to the nature of *integrated* storage; because all of the collected energy is stored before being dispatched, a CSP plant's output is far less sensitive to momentary fluctuations in sunlight. Weather conditions will only affect the number of operating hours – the MWh amount delivered per day – and will not affect the MW level that the system produces. Importantly, CSP with storage can also change its behaviour mid-life, 10 or 20 years after commencing operations, to adapt to new market realities. This allows CSP to maintain its value over the long term, even while the wholesale market value of additional PV or wind declines precipitously as more and more of those technologies are added to the grid.

Many independent studies have shown that CSP provides significantly higher value for its cost relative to PV and wind.[1] Output from a power plant is not purely a commodity – the timing, reliability, flexibility, rate of change, and exact amount of energy production all factor into the value for the price.

Wholesale Market Value

The energy landscape in Australia is rapidly changing as coal fired generation is phased out and solar and wind power gain traction. South Australia's reliance on interconnectors and intermittent renewable generators has increased the variability of wholesale prices which in turn has negatively impacted large industrial customers in the market. The situation which occurred in July 2016, where the Heywood Interconnector was out of service and intermittent generation was not producing electricity, saw the state supplied by gas turbines at prices well outside the normal range of prices in the market, at times approaching the market cap of $13,800/MWh. Whilst redundancy in interconnectors could have helped to overcome this price volatility, interconnectors remain vulnerable to failure as occurred in September 2016 when 23 transmission towers were destroyed by a storm. A more cost efficient solution which address both price volatility and energy security is for dispatchable renewable generation to be built in South Australia, which will provide diversity to the market during periods of existing interconnector maintenance or fault.

SolarReserve's CSP facility can adapt to the changing profile of the market, both now and into the future. SolarReserve's CSP technology is designed with price risk management in mind, featuring two key elements:

1. **High capacity factor.** SolarReserve's CSP technology can run for up to 24 hours per day throughout the summer months, smoothing intermittency generated by wind and solar PV and adding stability to the network. This guarantees that the facility will meet all high-priced times on the grid.

2. **High storage capacity.** When not running baseload, 8-12 hours of storage capacity (typical for plants of this scale) allows for unprecedented discretion in dispatch patterns. The facility could run principally at night during the winter, if it were advantageous to avoid hours when intermittent generation is generating. The dispatch pattern can adapt as markets change, allowing the CSP facility to adjust its behaviour following contingency events and as the States load profile changes over the next 20 years.

Independent studies have shown that CSP with a significant amount of storage is capable of consistently supplying electricity into the peak demand periods.[2] Additional studies have shown that intermittent renewables (PV and wind) without storage *lose their value* as additional

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[1] For a useful literature review, please see "The Economic and Reliability Benefits of CSP with Storage: Recent Studies and Research Needs," available here: http://www.csp-alliance.org/cspa-report/

[2] Madaeni, S.H., R. Sioshansi, and P. Denholm, "Estimating the Capacity Value of Concentrating Solar Power Plants: A Case Study of the Southwestern United States," IEEE Transactions on Power Systems, Vol 27, No 2, pp 1116-1124, May, 2012a.

intermittent renewables come on line, while CSP with storage maintains its value.[3,4] While some jurisdictions around the world have distinct market prices for both energy and capacity, the NEM is organised as an energy-only market, which means that price spikes up to $13,800/MWh are permitted during contingencies in order to reward the more reliable generators for being available. The effect of price spikes are significant: over the last ten years, the top 1% of wholesale pool price hours in South Australia represented over 25% of a potential generator's revenues. In other words, over 25% of a potential plant's value to the grid was made up of its ability to match the most needed 1% of hours. It is possible – and we suggest likely – that price spikes in South Australia will become more prevalent as variable resources like PV and wind increase their level of penetration, particularly during periods of interconnector maintenance or fault.

Opportunities for South Australia

In September 2016 SolarReserve announced plans to build six utility scale CSP facilities in South Australia. These facilities are planned to be built over a decade and will collectively have the equivalent capacity of the Heywood interconnector at around 650MW. Combined, these facilities will incorporate more than 5,000MWh of energy storage and will, supply the equivalent of 25% of South Australia's load. Importantly, the cost of these facilities will largely be captured within a bilateral power purchase agreement with a third-party electricity user, and not socialized to the broader community as an interconnection solution proposed in the PSCR will be. SolarReserve has identified the towns of Port Augusta, Leigh Creek, Woomera, Whyalla and Roxby Downs as being prospective host towns for these facilities.

The first of these projects is the Aurora Solar Energy Project. Aurora is located 30km north of Port Augusta, South Australia, where a grassroots campaign for a solar thermal plant has been underway for many years. SolarReserve recognised the importance of Port Augusta for CSP due to the confluence of its exceptional solar resource, availability of skilled workers from the nearby Northern Power Station, excellent land and grid connectivity. Aurora will be nearly identical to SolarReserve's Crescent Dunes facility in Nevada, now fully operational and delivering clean, fully dispatchable energy to the grid.

Aurora will be a 110 megawatt (MW) facility incorporating 8 hours of full load storage (880MWh). This configuration was optimised by analysing the last several years of load data for South Australia. SolarReserve is progressing the studies required to secure the necessary approvals for the project to proceed and hopes to proceed with the project in 2017. SolarReserve is currently tendering the electricity output from the project to the South Australian Government under the State's Request for Proposal process. If successful, SolarReserve will execute a power purchase agreement with the State which will underpin the financing for the project.

Advantages of CSP as a Non-Network Solution

SolarReserve strongly encourages ElectraNet to consider CSP as a viable non-network solution under the RIT-T process. CSP has several advantages over a traditional augmentation solution of building new interconnectors as proposed in the PSCR, including:

- **Cost.** The costs associated with a CSP facility are amortised over the life of the facility and are captured within the power purchase agreement price. They are not socialised to the broader community through increased network access charges as an interconnector solution would be. This enables the facility to deliver energy and renewable energy certificates to an electricity consumer, and in parallel provide benefits to the electricity network at least cost.

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[3] Mills, A., and R. Wiser, "Changes in the Economic Value of Variable Generation at High Penetration Levels: Pilot Case Study of California", Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, LBNL-5445E, June 2012b. See http://eetd.lbl.gov/ea/ emp/reports/lbnl-5445e.pdf.

[4] Jorgenson, J., P. Denholm, and M. Mehos, "Estimating the Value of Utility-Scale Solar Technologies in California Under a 40% Renewable Portfolio Standard," National Renewable Energy Laboratory, Technical Report, TP-6A20-61685, May 2014.

- **Reduction in price volatility.** Wholesale price volatility is reduced with a CSP solution as it increases diversity of supply in the South Australian electricity market. Unlike intermittent renewable energy technologies, CSP with storage can provide fully dispatchable electricity, which ensures that power is able to be provided to the market at the times of peak demand.

- **Increased energy security.** Indigenous generation constructed in South Australia will result in increased energy security to South Australia than a new interconnector can provide. Local generation that is distributed throughout the state provides enhanced risk management as it is less susceptible to an outage resulting from a single point of failure. Extreme weather events, as occurred in September 2016, caused significant damage to the State's transmission network which severed connection of loads in the North of the State with generation and interconnectors in the South. SolarReserve's proposal to build several CSP facilities in the North of the State would have overcome the 2-week outage experienced by some of the large industrial users of electricity in this part of the network.

- **Greater social benefit.** The construction of six utility scale CSP facilities in South Australia will create around 24,000 jobs for the South Australian economy and will require around 300 people to operate and maintain these facilities on an ongoing basis. An interconnector by contrast will create jobs during the construction phase but will not sustain any ongoing jobs in the operations and maintenance phase of the asset.

- **Increases use of renewable energy.** A portfolio of South Australian CSP projects will continue to advance the state and federal governments renewable energy ambitions, but with a fully dispatchable renewable energy technology rather than intermittent technology. CSP will contribute to these state and federal targets without introducing some of the challenges that are expected with increased penetration of intermittent renewables.

CSP can play an important role in providing the pathway from fossil fuel-fired generation to the renewable energy without necessitating the need for additional transmission interconnectors. Importantly, CSP can alleviate the need for additional interconnectors to provide energy security into the South Australian grid. If even a portion of the expected cost of an interconnection solution was provided as a financial contribution to the projects in recognition of the network benefits provided by these CSP facilities, the energy price (PPA price) of these projects would be able to be reduced which would better position them to move forward. CSP is yet to establish a foothold in Australia due to its higher cost than traditional intermittent renewables, although CSP projects provide much greater value to the broader electricity market. Dispatchability, energy security and the social benefits that CSP deliver are not currently valued, although are increasingly important in a rapidly changing energy market.

SolarReserve believes that CSP can provide a viable lower cost alternative to a new interconnector for South Australia and would strongly encourage ElectraNet to consider this technology in the PSCR, being conducted as part of the RIT-T. We thank you for the opportunity to contribute. Please feel free to contact me on 0428 928 894 should you wish to discuss any of the above further.

Yours sincerely,

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SOLARRESERVE AUSTRALIA