SOLAR FARM CONSTRUCTION LOG

==========

18/5

====

Rough estimate of profits. Cheapest solar panel. 31W system.

Given land size of 20m x 60m (conservative) may fit 1.4k units. $66 ea.

Sale cost of power: 10c/kWh.

Profit per day:

1kWh = 3,600 kWs = 3,600 kJ = 3.6 MJ

10c / 3.6 MJ so --> 31 W = 0.031 kJ/s = 892.8 kJ/d = 0.9 MJ/d

Converting to profit:

0.9 / 3.6 = 0.25 --> 2.5 c/d/panel

1,400 panels so:

Turnover = 1400*2.5 = $35/d --> $12.7k / y

Setup cost = $66 * 1400 = $92,400

ROI in 7.2 years

ROI ratio: 12.7/92 = 0.14

*The above is with cheapest panels. Must seek optimisation to decrease ROI time.

Mounts

Researched mount methods. Companies sell pre-built mounts with rotating heads.

https://aeesolar.com/wp-content/uploads/2018/01/2018-AEE-Solar-Catalog.pdf

Reading YouTube comments section of DIY video many people had no rotation. Models exist without rotation. Possibly cost efficient to have no rotation. Will research solar irradiance within Adelaide /min/day. BOM has this information.

Registered to access minute solar data with joepritchard.solar@gmail.com

Irradiance

Online ResearchGate commentors say: take total irradiance as totally convertible by cell array, as an estimate.

Direct SI = Total irradiance perpendicular to suns beam

Horizontal DSI = Horizontal component of DSI (earths surface)

Diffuse SI = Complement of HDSI. Results from scattering - assume ~0% ?

Perhaps: Only condier DSI

Mean DSI ~ 1k @ max

Mean Diff. SI ~ 70 @ max ~ 0.5% of total

Cool. Will use Mean Direct Solar Irradiance to measure irradiance with tilt.

Will use Mean Horizontal Direct SI to measure no tilt.

Mean Dir. SI : col 68

Mean Hor. DSI : col 188

====

19/5

====

Comparisons between panels using: profit per area.

Previous: ROI == 0.14

New model: 130 W, A == 0.856mx1.01m == 0.864 m^2

Progress

========

Searched and compared ROI/m^2 for various panel types.

Found product with 0.5 ratio but upon further reading is only 24% efficient. So is really 0.125. Given the plan to reinvest in new panels every month and add to the array, may be possible to settle for lower ROI ratio.

* Will add efficiency rate into MATLAB code and continue evaluating more panels.
* Build in the monthly reinvestment strategy into the ROI MATLAB model.

Searched for land in SA. Land in Waraloo. $12.5k for 1650m^2.

*Search for smaller plot sizes for cheaper.

Searched for land for lease. Nothing found.

Searhed for government funding. Nothing found fitting this project.

20/5

====

Found government incentivised small scale technology certificates. Issued one per MWh generated. Value ~$22.

1MWh = (1/3600)MWs = (1/3600)MJ

ERROR: c/kWh to dol/MJ conversion was incorrect. Adjusted and ROI ratio doubled ! Factoring in remaining parameters next, even 50% reduction leads to min 2 year ROI, less with reinvestment strategy.

22/5

====

Attempted to define two angles from data given for suns position. Complicated. Instead will assume circular visible region. Use only zenith angle and visibility of 54 egrees from peak.

25/5

====

Zenith angle == distance from apex.

Azimuth angle == NESW

Hour of day == distance from horizon in plane of sun

26/5

====

Contacted SAPN. Method to connect panels to network:

1. Have panels approved and installed.

2. Contact electricity provider and provide Solar approval number.

3. Electricity provider install solar compatible smart meter - this meter

connects panel array to the grid.

Government Website outlines more comprehensive rules:

https://www.sa.gov.au/topics/energy-and-environment/energy-efficient-home-design/solar-photovoltaic-systems#title4

SA gov website says must complete a 'small embedded generation application

form' on the SAPN website for 'permission to connect to the grid':

https://www.sapowernetworks.com.au/incapsula-redirect/connections/connections-alterations-and-disconnections-forms/apply-for-a-new-service-provision

SA gov website says 'requirements for connection elec. installation to the

grid are given by the SAPN SI rules:

https://www.sapowernetworks.com.au/industry/service-installation-rules/

Reading Installation requirements of SAPN:

- Additional requirements in 'Electricity Distribution Code'
- 'Connection Contract'
- 'Electricity Metering Code'
- All the above available on the SAPN website

- All electrical work must be carried out by 'registered Electrical Workers'
- How to become a registered electrical worker ???

4.4.1 : Must comply with EA (Electricity Act) and EGR (Electricity General Regulations)

must also be 'suitable for interfacing' with SAPN

5.3 : 'Connection and Supply Contract' or 'Offer Letter' specifies conditions of connection to the network

5.4.2 : Use of ciruict breakers OR Load Management Systems are acceptable methods for controlling the load to SAPN. Fuses are not acceptable.
- sub clauses contain specs regarding requirements of these systems.

* Document states process for connection is outlined on the SAPN website (Main page - under connections --> small business connections)

On this webpage a document is referenced for the cost of making a site conneceted to the grid:
https://www.sapowernetworks.com.au/public/download.jsp?id=310854

If the site already has a connection point - EG if previously a residential property - then the site is already connected and no cost is incurred.
Info about connection installation fees is covered in this document:
https://www.sapowernetworks.com.au/public/download.jsp?id=310854

Depends on how easy it is to connect - Roads in the way, need to go under ground etc..

*Found directions specific to solar generator connection - searching for the

first document which originally wouldn't load. New form is being created.

Will be released in the coming days:

https://www.sapowernetworks.com.au/public/download.jsp?id=310854

Small Energy Generator (SEG) requirements

==========

Cost for SAPN to connect a site to the grid (construction costs):

https://www.sapowernetworks.com.au/public/download.jsp?id=310854

List of approved inverters is provided.

List of additional specifications.

* Inverters must be listed on the CEC list
* Certified to IEC 62116
* Have a Volt-Var (Volt Variable) response mode
* Have a Volt-Watt response mode

Checked Inverter costs:

https://www.renugen.co.uk/abb-pvi-8-0-tl-outd-fs-8000w-three-phase-inverter-g83-1/

Cheapest ~$1k

Currently browsing list of approved inverters on:

https://www.cleanenergycouncil.org.au/industry/products/inverters/approved-inverters

This approved list is referenced on the SAPN website here:

https://www.sapowernetworks.com.au/data/304457/small-embedded-generation-new-application-form-inverter-requirements-and-three-phase-export-limits/

Currently range seems ~$1-5k. $1k for ~5kW max output inverter.

*If possible, search for cheaper inverters

*Assess what the inverter actually does - perhaps an inverter with lower

max power output will suit my needs sufficiently

*Potentially only a few panels per site...

Found video illustrating summary:

https://www.youtube.com/watch?v=hC4xQXy-sGg

*Breaker system - prevents uninetend dangerous grounding

*AC Disconnect system

*Inverter system - Converts DC to AC

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====

Found 2.2kW Inverter - $880:

https://wholesaler.alibaba.com/product-detail/Jntech-new-design-2-2kw-single_62033724138.html

5kW Inverter - $2.1k

https://www.wholesalesolar.com/2931735/sma/inverters/sma-sunny-boy-5.0-us-41-inverter

2kW Inverter - $699

https://www.springers.com.au/shop/product/growatt-2000-s-growatt-2000-s-solar-inverter-10310

7kW Inverter - $1.34k

https://www.tradezone.com.au/product/growatt-7kw-single-phase-solar-inverter-with-dual-mppt-ip65-with-wifi-capability-78622.html

Grid specs research

==========

Read in an online post - Common connections feature 3 wires. two live, 180 out of phase, and one 90 degrees out of phase.

At the connection points circuit breakers are installed which will break grid connection of these two wires.

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====

Costs of installing an SAPN grid connection point from aforementioned document. Ranges fro $350 - $1k. For residential properties may be no cost. Depends on specifics of the property location and what existing SAPN infastructure is in place.

**When inspecting prospective sites, asses what SAPN infastructure already

exists, then contact SAPN to receive exact quote on set-up.

20/5

====

Figured out overview of total project. Given the output of the panels, 3 processes must be performed:

- Amplification : Raise voltage to grid voltage
- Inversion : DC->-AC
- Phase Locking : Allign phase to grid phase

Depending on how many wires grid connection has, lock phase and voltage accordingly.

This is cheap to do with micro-electronics with low voltage thresholds. Phase lock chip ~$100, others cheaper. (Mouser Electronics Online Store)

Having these approved by SAPN may take a while (Unknown) so would be efficient if I could use a pre-built yet cheap system. Will search SAPN approved inverter list again.

Searching for inverters by going from the CEC list. Best finds listed below:

$1189 - 5kW

Searched many other sites. Price is generally in the range of $1k

With this product, $200 panel giving 300W, 16 panels give 5kW of power. This gives $74 per panel. All the above are over estimates. Rerunning simulation with these values.

31/5

====

Searching for Inverters:

https://www.rasuni.com/products/abb-uno-dm-2-0-tl-plus-b-q

https://library.e.abb.com/public/66cfe1da44624726b89cd3d2233b8a01/UNO-DM-TL-PLUS_Q_1.2-2.0-3.0_9AKK107046A8885_revB_EN.pdf

$1162.67

2kW

1 MPPT

Max Power Input : 2.5kW

Weight : 15kg

Max Output I : 10A

Max Output V : 180 - 264 V

Max input voltage : 300V

Max input current : 10A

Output Frequency : 50/50Hz

Found 270W Inverter:

$143

https://solarbatteriesonline.com.au/product/s270-72-ln-2-au/

Found a blog site discussing solar:

https://forums.whirlpool.net.au/archive/2526530

NEXT STEPS

==========

1. Find type of connection to inverter and solar panel.
2. Look for cost of cable of varying lengths, must match (1).
3. Find how power is generated from panels - use this to find efficiency of series and parallel.
4. Inspect my houses grid connection box and check:
    - How many incoming wires
        - I expect 2: one for the AC, one 0V - called "single phase"
    - How these wires are connected to the house circuits
    - How the circuit breakers are set up
    - Check connection type: what type of wire could I connect in
5. Email SAPN and ask for specifics regarding connection:
    - If I have an empty plot next to overhead lines:
        - How much to add a connection ?
            - Specify sole purpose is solar panels
              may have different cost to residential eg. may
              allow an underground connection where residential
              does not.
    - Grid connection is: Grid-CB-Meter-CB, which of these will
      SAPN install and at what cost ?
    - What is the construction of the connection point:

- Are there SAPN restrictions on the type of cable which may be connected to this connection point ?

- Are there current, voltage or power limitations for the connection point supplied by SAPN ?

Answers:

SAPN does not install meters. Must search for an independant installer

-

2/6

===

From inspection of house fuse box:

Wire comes in from grid, second wire present appears to be from earth.

Both wires enter a meter. From this meter the two wires enter the circuit breaker box. From here assuming to the house.

I expect SAPN will install the wire, set up the earth, install the meter.

* Will they install the circuit breaker box or must I do that ?

From here there will be guidelines they require for type of wire connected.

Emailed SAPN on FB using EnergySolutions.SA@gmail.com profile, name 'Jack Smith'.

Browsing Solar Panels on:

https://www.solaronline.com.au/solar-panels.html

Examples:

160W

1.48 x 0.68 m

$190

80W

0.77 x 0.67 m

$135

275W

1.65 x 0.992 m

$275

290W

1.64 x 0.992 m

$280

Last option produces $900 per annum with initial investment of $3.8k

Searching for Land

==========

Two plots close to ADL:

Gulnare, SA

2.5 hr drive

1,177 msq

$9k

https://www.realestate.com.au/property-residential+land-sa-gulnare-202218286

Peterborough, SA

3 hr drive

900 msq

$9k

https://www.realestate.com.au/property-residential+land-sa-peterborough-202293922

Coober Pedy, SA

9 hr drive

1,196 m^2

$7k

https://www.realestate.com.au/property-residential+land-sa-coober+pedy-202514090

Land area is no constraint. For 16 solar panels each 1msq area, with 1msq spacing, maximum space needed is 49 msq. Easy.

Angles:

Minimum visible angle above horizon can be found using:

$$\sin\left(\frac{1}{1+n}\right)$$

Where n is the number of panel lengths between each panel.

Currently projecting a 3 year return.

* Need to look into wire costs, then optimising each aspect of the project !

* First need to look into profit for tracking vs tilting

TO DO's

=======

1. Find type of connection to inverter and solar panel.

*

2. Look for cost of cable of varying lengths, must match (1).

* Cheap - brief look gives ~$6.60 per meter.

May need more stringent specs...

https://www.wholesalesolar.com/9910200/wholesale-solar/cables/10-2-tray-cable

3. Find how power is generated from panels - use this to find efficiency of series and parallel.

* Charge is generated at a rate proportional to the amount of sunlight hitting the panel. This charge carried away by the circuit current. Higher current gives more power. An upper limit on current is set by the panel with the least amount of sun exposure.

* Can build this into the model by:

- when a dip in sunlight is observed, set the surrounding sun values to match this. As though the clouds were over adjacent panels, limiting the power producable by the current panel
- More panels in series means greater influence period.

4. Inspect my houses grid connection box and check:

- How many incoming wires
    - I expect 2: one for the AC, one 0V - called "single phase"
- How these wires are connected to the house circuits
- How the circuit breakers are set up
- Check connection type: what type of wire could I connect in

* Makes sense. SAPN provide two wires in - one AC and one grounded.

6. Selling of electricity (can increase electric value from 20c to 30-40c)

- Meter on my property tracks how much I deposit to the grid.
- Customers meter tracks how much they use.
- If I cannot supply a consumers full energy needs must they then change supplier ? Is it possible to enter into some form of agreement with another supplier ?

*

7. Building permits. Research what type (if any) of approval is required by council to allow for the building of the farm.

*

8. Research costs associated with land:

- annual land tax

- potentially a stamp duty?

* Stamp Duty $70 for $7000 plot, by online SA calculator: https://www.revenuesa.sa.gov.au/taxes-and-duties/stamp-duties/calculators/stamp-duty-on-conveyances-calculator-new

* No Land Tax by online SA calculator: https://www.revenuesa.sa.gov.au/taxes-and-duties/land-tax/calculators/calculate-land-tax-2019-20

9. Research cost of pre-built mounts. Depending on cost efficiency

potentially self-build.

*

10. Are there V, I or P limitations on SAPN connection. Read document in FB

message from SAPN to search for. If not clear, message SAPN asking for

clarification.

*

11. How much to install an SAPN connection. Read installation document and

search for specifaction relating to a private plot containing only solar panels.

If cannot find this explicitly listed, message SAPN asking if this is included

in a standard (free) residentail connection, or if alternate fees apply.

*

12. Check if SAPN have limitations on what systems may be connected to their

network. Any limitations on types of:

- wire

- solar panels

- inverter

*From reading no, all info in TSs. Also can apply and they will approve/reject

13. Do I need to step up my Inverter O/P voltage ?

- No, Inverter does this already.

14. Cost to install meter through origin ?

- No cost.

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====

Reading installation document. (Downloaded). Numerous references are made to notifying SAPN BEFORE construction begin. Interpretation is they will approve is disprove the connection. Implication is also they will cross check with regulations and Acts. This will save me needing to do myself, can instead propose connection and they will provide feedback as to what is needed in addition.

Standard enquiry and application forms exist on the SAPN website - I provide specs of my connection and they then approve / disprove it. All necessary info will be in the docs...

6.6.4.1 Inverter Requirements

Max single phase inverter is 5kVA.
Max 3 phase inverter is 30kVA. - no more than 5kVA tolerance between phases.

Specs in Technical Standards: TS129, TS130 and TS131

Must provide 'Type Test' certification prior to grid connection.

6.6.4.2 Installation and Connection to Grid (TIR)

Must attach Inverter to switchboard via a 'lockable isolating switch'.
This must isolate all supply to the switchboard including any associated control circuits:

- Must seperate control circuits from switchboard.

Clearly label switchboard and circuit breaker/fuse/ switch has Inverter connected.

Attach label saying alternate power supply connected at meter location and switchboard.

IF have multiple inverters all must be connected to a 'Network Protection Unit'.

- all 'National Meter Identifier' (AKA the meter device) points must be connected to a single 'Network Protection Unit'.

Inverter settings cannot be altered without seeking reapproval from SAPN.

6.6.4.3 Metering (TIR)

Must have a meter.

6.6.4.4 Standard Networks Connection Agreement (TIR)

Possible connections limited by an 'approved standard connection agreement'

- on the SAPN website

Trialing online application form:

- Needed to specify what type connection point was:
    - Ground level transformer
    - Pole top transformer
    - Over/Under
    - Fused Pit
    - Overhead
    - Unfused pit
- Maximum Ampere demand
- Are there off-peak loads required to the property
- Need licenced contractor details:
    - Lecence number
    - Business Name
    - Photos of the property:
        - Image of block requiring conenction
        - Image of SAPN connection point (eg transformer)
        - Wide angle shot providing context of surrounding land and position relatvie to the road.

TO DO:

- call Origin and ask about cost for installation of a meter AND how much they will buy solar electricity for.

- Read site requirements listed here: https://www.sapowernetworks.com.au/public/download.jsp?id=9704

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====

Reading terms to export electrical energy to the grid: https://www.sapowernetworks.com.au/public/download.jsp?id=9704

Process:

- Once submit application, SAPN will advise within 10 business days whether Small Generator Basic Connection (SGBC) is allowed
- If so, contract of SGBC comes into effect

- Once SAPN accept application letter and deem it fits those of a small generator system, this contract comes into effect.

- Start date of installation and completion 'agreed upon' elsewhere, potentially in the application document - if these dates are not 'agreed upon' elsewhere, SAPN provides no timeframe for completion

- Generator must be installed by 'licenced electrical contractor'

before application is accepted.

- Must carry out 'preliminary work' (???) before connection starts
    - Is this after application accpeted ? Check with SAPN

'Preliminary work' and 'pre-conditions'

- Must already have a contract stating premises is to be connected to SAPN network
- This will be covered in the connection document below

- Must have engaged a Clean Energy Council accredited installer for the design and installation of the generator.

- Generator must comply with AS 4777 parts 1,2 and 3

- Generator must have been connected in accordance with AS/NZ 3000 - wiring rules

- Must complete 'any additional documents' SAPN requires. This includes 'Application for SEG Approval Reference Number'
    - Ask about these

- Must provide a written confirmation letter from an electricity retailer that it has entered into an agreement with the 'premises'

Protect SAPN

- When they are on land, must secure all equipment

- Ask, is a metal box, locked, acceptable ?

- This limits my expense

Export requirements:

- Must have meter that tracks import and export amount

NOTE:

- Connection is subject to interuptions

- Ask SAPN how often this occurs, and how it occurs

- does voltage drop to zero at connection point ?

- If so, I need to protect against this

General requirements:

- Must abide by AS 3000 - Wiring Rules

- Must abide by AS/NZ 3008 - Electrical Installations: Selection of Cables

- Abide by Service Installation Rules for SGBC.

- Abide by Electricity Act 1996

Congoing contract:

- Ongoing connection rules covered by:

(Ongoing Connection & Supply Contract);

After connection:

- Ensure if supplied voltage exceeds 257 Volts connection will

automatically disconnect

- Inspect at least every 5 years by qualified person, provide SAPN with results of the inspection
- Seek SAPN approval in writing to alter the system

Deign specs:

- Abide by AS 4777 - Grid Connection of Energy Systems via Inverters, parts 1, 2 and 3
- AS/NZS 3000 - SAA Wiring Rules
- AS/NZS 3008 - Installation of Photovoltaic (PV) Arrays
- all other 'applicable AS/ codes of practice' - How I know ???

Grid specs:

- SGBC must match voltage, frequency and waveform of the network.
  Any distortion of these parameters must be within acceptable limits.
  - I assume 'parameters' refers to my site params. What are the +/- tolerances of my matching ?

Inverter specs:

- Inverter must abide by AS 4777.3:
  Grid Connection of Energy Systems via Inverters Part 3: Grid Protection Requirements
  - In summary this is:
    - Inverter disconnects in the event of 'loss of supply'
    - Inverter operates within params of network matching
    - Inverter does not energise a de-energised circuit.

Multi-phase specs:

- 3 phase Inverters must enseure 'reasonably' balanced output of all phases
- All 3 phases must disconnect from, or connect to, the network at the same time, in response to protection or other controls
    (Eg: anti-islanding trip)
    - Pretty much, ensure 3 phases are all connected via same circuit breakers
- If use single phase invertes to connect to 3-phase
    - All must be 'interlocked' to provide a balanced output
    - OR, if cannot interlock, installation must have a 'phase-balance relay' which isolates the inverter in absence of reasonable balance. Inverters also must be 'physically prevented' from operating independantly. All Inverters must disconnect/ reconnect simultaneously
- 'reasonably balanced' def: no greater than 5kW

Volt and freq specs:

- Must abide by Australian Standard AS 4777 (Grid connection of Energy Systems via Inverters)

Volt:

- 'Max voltage limit for sustained operation', Calibrated over a period of 10 minutes or less, must be no higher than 257 Volts.
- If this parameter not settable in Inverter, instead anti-islanding maximum voltage trip point (based on short term measurement) must be set low enough to 'ensure compliance'
    - I think 'ensure compliance' means to limit to 257V

Freq:

- Minimum: 48Hz

- Max: 52Hz

If either outside range, must automatically disconnect from network.

Reconnection must follow AS 4777.3 “Grid Connection of Energy Systems via Inverters Part 3: Grid Protection Requirements”.

- Potentially I can make automated reconnection system, so I don't have to physically visit site each time - actually may not trip often so may be okay.

Specs:

- small generator defined in AS 4777
    - Doc defined for: energy inverter systems up to 10kVA for single phase, 30kVA for three phase
    - Must also account for SAPN restrictions
- Max of 10kW per phase, max inverter size of 10kW (export limited to 5kW ?) for single phase

- For 3 phase, up to 30kW inverter size, no more thn 5kW difference between phases

NOTE: If generator sold, contract must be re-applied for.

Note: Fee for exporting is here:

http://www.sapowernetworks.com.au/centric/industry/our_network/network_tariffs.jsp

Coniditions to allow the initial connection are here:

http://www.sapowernetworks.com.au/centric/customers/necfconnections/necfresidentialconnections.jsp.)

SIR referenced here:

http://www.sapowernetworks.com.au/centric/industry/contractors_and_designers/service_and_installation_rules.jsp

Also: Does not allow sale of electricity to my premises, that is handled by

an independant energy retailer.

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===

Digesting guidelines and AS

NOTE: From university portal I find AS4777.1 and AS4777.2 listed as most

recent version. AS4777.3 is listed as 'historical' and no newer releases

are available. Part 3 relates to 'grid protection equipment'.

I assume AS4777.3_2002 is the most recent edition based on this.

CHECK THE ABOVE WITH SAPN.

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===

Re-ran simulation

By placing panels flat on ground, cost of material drops from $150/panel to $20/panel. This means net investment WITH inverter is $5.795.

Including Land of $7k we have: $12.795k investment.

This produces a return of $1.5k per year.

Panel + material + inverter cost is returned in 4 years.

With optimisation, tracking panels, may be able to improve this. As a base this ROI is satisfactory enough for me to proceed.

Still need the cost of SAPN connection:

- I have messaged them, awaiting on reply about how to gain access to the form they sent.

Still need cost of Australian Standard Compliance:

- CEC accreditation
- Electrical Licence
- Breakers + other components to be found

CURRENT PROJECT OVERVIEW

==========

Simulations provide a 4 year ROE for construction.

Cost of construction is: $5.795k

Total investment is $12.795k

Still need the cost of:

- compliance with SA standards
- to construct SAPN connection

From a simulated stand point the project is acceptably profitable. The next step is to interpret SA standards to find:

- necessary compliance steps
- cost of necessary cmopliance steps

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===

Begin reading AS.

Noted on AS website, AS4777.3 is superseded by AS4777.2 (2005). Do not need to read AS4777.3 as a result. (Yay)

AS4777.1:

=========

Pg. 4:

Must be read in accordance with AS/NZS 5033: Installation and safety requirements for photovoltaic arrays

1.1.1: Applies to IES up to 200kVA

2.3:

Rating limit is 5kVA at max for single phase. If multi-phase, unbalance between phases must be max of 5kVA. This refers to the output of the inverter connected to the grid, not the PV array.

If 'domestic dwelling' - no point must exceed 600V. For all systems, if point exceeds 600V, the entire installation must have 'restricted access'. Restricted access if: calbling is in 'heavy duty conduit'. Equivalently, may enclose cable, from the point of excess up to and including the inverter, in a casing that cannot be opened without the use of a 'tool' - Think this just means a tool of any kind.

RCD: Residual Current Device == Residual Current Circuit breaker

==========

SECTION 3: CONNECTING IES TO MAIN SWITCHBOARD

==========

3.1:

Vague overview of IES requirements

All switchgear must be 'enclosed against external influences' - AKA put in box

3.2.1:

IES must connect to a dedicated circuit on a switchboard. Must connect via 'fixed installation wiring' OR coupling arrangement using flexible cord (more on flex cord later).

May connect IES 'Auxillary equipment' to the main switch (Inverter supply).

3.2.2:

IES should connect directly to the main switchboard.

3.2.3:

Info about the use of 'flexible cable' - I will likely use 'fixed installation' cable - meaning it is not freely displaced without disassembly.

If the inverter has a 'connecter' - I think this is where I must make the connection between the wire and inverter - it must comply with IEC 60309-1. Inverter connections must follow rules set by manufacturer.

Inverter connection must have NO accessible live parts, under any conditions.

3.3.1:

Wires must have a current carrying capacity at minimum that which is max supplied by the IES when: Inverter provides power given input voltage not outside 'maximum input limits' of the inverter.

- This is the maximum current suppliable by the inverter, when voltage in is within the inverter limits - this should be specified on the inverter info sheet.

If Inverter is multi-mode - it is installed to function when grid tied AND when off-grid - current capactity of wires must at min be the max of the generating output and the load input.

3.3.2:

Cables may not lie on roofs or floors without an enclosure or conduit.
Must not obstruct natural water draing paths or cause accumulatino of debris.
Must protect cable from wear and tear throughout its lifetime.
All conduit and 'ducting' - ducting is an enclosure of anykind - shall be of a UV resistant type - defined in AS2053.1 AND AS61386.1.

All cable supports must have a lifetime greater than or equal to the expected life of the IES

3.3.3: Voltage Rise

Voltage rise between supply point and IES must not exceed 2% of the supply point voltage (EG: 257V (ish) at grid). This is calculated by using the rated current of the IES. Equations for calculating this are included Appendix C, page 58 of the standard - use these when confirming acceptablitiy of wire.

3.4: CONTROL AND PROTECTION

3.4.1:

Switchboard must have a main switch where the inverter supply is connected.
Main switch must function according to the rated current of the IES.

3.4.2: Overcurrent

cables must protect against overcurrent following AS/NZS 3000. If no other over current protection provided, the main switch MUST be a circuit breaker.
CB rating must match fault currents caused by IES output OR the supply IP.
Supply IP fault currents - I think ask SAPN.
Inverter fault currents - read inverter documentation.

3.4.3: Isolation Switches

Must be able to be secured in the open position.
Must be able to break the rated current of the IES.
Must isolate the IES from the switchboaord.
Must be labelled as specified in section 6.
Must be installed in accordance with AS/NZS 3000

The overcurrent AND isolation requirements may be satisfied by a single circuit breaker capable of being fixed in the OPEN position.

If the inverter is not 'adjacent' (within 3 meters, visible from each) to the switchboard, an additional isolating switch must be adjacent to the inverter, capable of being secured in the OPEN position.

The isolating device shall not be located within inverter - the inverter must be able to be disconnected while having the switch independantly in OPEN.

There are conditions where 3.4.3 does not need to apply - if looking to cut costs potentially look into this.

3.4.4: Central Protection

Must have islanding protection for the grid.

Protection must be as close to the main switch as possible.

This is in addition to the Inverter protection.

Central protection settings must only be adjustable by use of a tool AND special instructions which are controlled (only by request). NOTE: 'Special interface devices' and passwords are regarded as tools. Me: perhaps a lock and key is then also ? would save on expense. Maybe electronic password is not expensive anyway..

Protection required is summarised in a table, based on the rated power of the combined IES.

If <= 5kVA per phase:

- Use AS/NZS 4777.2 for requirements.

If 5kVA < Power < 15KVA:

- Must also have Phase balance protection

If >15kVA:

- Must also have central voltage and frequency protection

3.4.4.2: Phase balance protection

3.4.4.3: Central Voltage and Frequency Protection

3.4.4.4: Connection and Reconnection Procedure

- Voltage must be maintained within the limits of AS60038 for at least 60s
- Frequency has been maintained within 47.5 to 50.15 Hz for at least 60s
- The IES and the grid are synchronised and in-phase with each other
- No external disconnect signal is present or DRM 0

NOTE: Voltages for reconnection in Australia may be in the range 205V to 255V

3.4.5: Residual Current Devices (RCDs)

An RCD may be used to meet the requirements of AS/NZS 3000, in place between the switch board and the IES.

RCD must:

- disconnect all live conductors (including the actives and neutral)
- Be in accordance with the requirements specified by the inverter.
- NOTE: If inverter manufacturer requires protection GREATER than 30mA other forms of protection must be used, NOT RCDs - see AS3000

3.4.6: Demand Response Mode (DRM)

I may have a 'Demand Response Enabling Device' (DRED) - This device provides input to the inverter affecting its function, namely the output power.

Must connect it to the DRM port of the inverter.

3.4.7: IES Operational Settings

Inverter Protection is covered in 4777.2

Additional changes to the IES required by SAPN must be recorded in the system manual - ME: presumably this is a logbook kept with the Inverter.

3.4.8: Export Control of IES

Export Control function may be interanl OR external to the Inverter.

Changes to Export Control Settings must require a tool.

There are:

- Hard limits: exceed max export limit
- Soft Limit: approach max export limit

3.4.8.2: Hard Limit

If net export limit is exceeded for greater than OR EQUAL TO 2 seconds, the disconnection devices (islanding switch, circuit breaker etc) must be activated.

If the IES loses connection with a component required for export control, the IES must operate the disconnection devices.

If the export control function has a hard limit set, it must detect fault of the ECF and operate the diconnection devices.

3.4.8.3: Soft Limit

If Soft Limit is exceeded, export must be adjusted within 15 seconds.

If disconnection with export control occurs, export must be reduced to soft limit (as a maximum). Connection must be stable for at least 60 seconds before reconnection to the export control function.

If export control function is required to have a soft limit, it must detect
any fault or loss of operability and reduce IES active power output to zero.

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SECTION 4: CONNECTION OF INVERTER TO ENERGY SOURCE

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4.2:

If using flexible cable coniditons apply, listed here.

If inverters port connections meet the requirements of pluggable equipment
type B, then I MUST use connectors satisfying pluggable equipment type B specs

Connectors must follow Inverter manufacturers specifications.

From a PV array connectors must follow AS5033.

4.3.1: Cabling

Cabling must follow AS3008.1 and AS3000

Positive and negative cables of individual circuits should be bundled together
(I will do this) - so have positive and negative cables run back in tandem,
tied together with a plastic restrainer.

4.3.2: Cable Labels

Must have a label at least every 2m.

Must state: This is an energy source cable - AND the type of energy source.

Examle AS provides is 'SOLAR'

Must be: permanent, legible, indelible.

If cables are enclosed, the enclosure must have labelling every 2m.

4.5: Isolation Devices

Must be installed between Energy System and Inverter.

Must be able to be secured in the OPEN position.

Must follow AS3000.

Isolation device must be adjacent to the energy system.

Semi-conductor devices ARE NOT PERMITTED for isolation purposes.

Isolating device must not be internal to the inverter.

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SECTION 5: ADDITIONAL REQUIREMENTS

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5.1.1:

Inverter must have earth leakage and insulation monitoring - or have instructions

on how to achieve this.

5.1.2:

Must have insulation monitoring - more in AS4777.2

5.1.3:

Residual Current Detection must follow AS5033 and manufactureres instructions.

5.2: Segregation of Circuits

If a casing has both AC and DC wires, extra coniditons apply, listed here.

All AC and DC wires must be at least 5cm away from each other or extra conditions apply, listed here.

5.3: Inverter Installation

5.3.1:

Inverter must be placed so dust, insects, water etc cannot accumulate around it as would damage the long term function of the inverter.

Should be installed in accordance with the IP rating of the Inverter.
IP is a rating provided by IEC stating the extent of protection required for a given installation.

5.3.2: Equipment Weatherproofing

Protect equipment against the accumulation of rain water and condensation.

5.5: Multiple IES

5.5.1:

Where multiple inverters connect to a single main switchboard:

- There must be only one main switch
- Each IES must have its own isolating switch

Each portion foreseeable for independant testing and work must be able to be seperated by isolating switches. - Me: pretty much put isolating switches on every new wire segment.

5.5.2: Multiple inverters with <5kVA per phase

May use a single isolating switch for all three inverters, positioned adjacent to the inverters.

Addtional clauses apply, read here for more info:

If Inverters not adjacent each must have its own isolating switch.

The cabling from the inverters AC isolator to the connected inverters must be protected against over current.

5.5.3: Inverters on the Same Switchboard

For clauses regarding multiple inverters on the same switchboard read here.

5.5.3: Inverters on different distribution switchboards

For info about mutliple inverters connected to individual switchboards read here.

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SECTION 6: SIGNS AND LABELS

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6.1:

All signs must have lifetime >= to that of the IES.

Must be indelible.

Clearly visible.

6.2: Signs for Main Switchboard

Must place labels on the cover of the switchboard.

Follow the instructions here when at this stage.

6.6: Demand response mode Labelling

Must label the demand response modes of the Inverter. Place label on top of the inverter.

6.7: Signs for Shutdown Procedure

A sign detailing shutdown instructions must be positioned adjacent to the switch which provides shutdown functionality.

Required text is given herein.

6.8: Signs locatd adjacent to Inverters

Isolating switches adjacent to the inverters must be labelled. Text given

herein.

6.9: Signs for multiple IES

For multiple IES are present must label such that it is clear which labels apply to which equipment.

6.10: Signs for Multiple Energy Sources

If multiple energy sources (EG: many PVs), must plce a label stating:
"All energy sources shall be turned off to achieve complete isolation".

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SECTION 7: SYSTEM DOCUMENTATION AND COMMISSIONING

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7.2: Manual

A manual must be present on site with info about the IES. It's contents are listed herein

7.3: Verification

Must follow AS3000.

Must also record details about the inspection, conducted in accordance with AS3000. These details must be added to the manual. Read the list to know what to record prior to the inspection. This list includes the inspectors SIGNATURE

7.3.2: Initial Verification

Must follow AS3000.

Must record all programmable set points and the requirements which have led to these set points.

Must include:

- person responsible for the design
- recommendation of period before subsequent verifications.

Initial verification report must be included in the manual prvided with the IES.

7.3.3: Periodic Verification

Must be performed matching the requirements of the equipment manufacturers.

Must abide by AS3019

7.4: Visual Inspection

Must follow AS3000

Must also follow:

- All of the requirements of AS4777 and everything else I have read.

7.5: Testing

Must follow AS3000.

Must also test export limit function, if one is installed.

7.6: Commissioning

After inspection and testing are completed the IES may be commissioned (turned

on).

After commissioning, tests that must be performed are listed herein.

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AS4777.2

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5.1:

Inverters must comply with the appropriate parts of IEC 62109-1 AND 62109-2.

5.2:

Inverter must be fixed - not able to be moved.

All inverter ports must either have:

- pluggable type B connections.

OR:

- permanently connected cables.

Pluggable type B connectors must have:

- Non detachable cord

OR:

- An inlet requiring a matching connector for connection

Pluggable type B connector must NOT have:

- a type as shown in dimension sheets of AS60320.1
- A plug (defined in AS 3112). Me: presumably this is a standard socket plug
- hazardous voltages accessible by the standard test finger (defined in IEC 62109-1)

5.3: Earth Fault / Earth Leakage Detection

If earth fault detection or residual current detection is required, it must be declared in accordance with IEC 62109-1 AND IEC 62109-2.

If a Residual Current Device is required, it will be specified in the Inverter manufacturers installation instructions. This will also specify the rating, type and required circuit location. THIS WILL BE CHECKED BY INSPECTION.

'Functionally Earthed PV Array Detection' may be necessary by AS 5033 - if so, this detection feature must, before start up of the system:

- Open circuit the functional earth connection to the PV array
- measure the resistance to earth of each conductor of the PV array
- If the earth resistance is above that specified in table 1, the system must reconnect the functional earth and power on the system
- If the resistance is equal to or below the limit, the inverter must shut down and issue an earth fault alarm in accordance with IEC 62109-2.

Table 1:

If Inverter rating is <= 20kVA:

- Resistance limit is 30 Ohms

5.4:

f and V of inverter must follow AS 60038

5.5: Displacement Power Factor

Displacement Power Factor of the Inverter, when current is 25%<I<100% of the rated current output, must operate at unity power factor within the range 0.95 leading to 0.95 lagging

Operation at power factor other than unity is acceptable where the inverter is in 'power quality response mode'.

This will be tested using the 'Power Factor Test' BY AN INSPECTOR. Test is specified in appendix B.

5.6: Harmonic Currents

Odd and Even harmonic allowable percentages are specified in the table listed within this clause.

The 'Harmonic Current Limit Test' will be applied to test this.

Inverter must also not radiate or sink frequencies for ripple control by SAPN - I must ask SAPN what these frequenices are and cross check with the inverter manufacturer.

5.7: Voltage Fluctuations and Flicker

Must abide by AS 61000.3.3: Voltage Fluctuations and Flicker limits for equipment with rated current less than or equal to 16A/phase.

If the rated current output is greater than 16A/phase (AC), if the inverter cannot meet the limits specified in AS 61000.3.3, the impedance at the connection point must be set to meet the limits. The impedence is calculated using the method specified in AS 61000.3.11. Note: P_st, P_lt, Z_max or Z_ref must be included in the Inverter documentation.

Inverter must remain connected during the test and the automatic disconnection device must not activate.

5.8: Transient Voltage Limits

When the Inverter is disconnected from the grid, the transient voltages present must not exceed the values listed in Table 4 herein.

The 'Transient Voltage Test' in Appendix D will be used to test this.
NOTE: The vertical line diode in diamond symbol is a full wave rectifier.
It converts an AC signal into a purely DC signal. The magnitude of the DC is equal to half the amplitude of the AC. - AC negative is flipped, then all bumps are averaged, giving 1/2 the amplitude.

The 'voltage-duration' curve (a plot of voltage vs time) may be calculated by taking measurements using the 'grid interactive' port of the inverter.

Me: as a summary: Use the grid interactive port to measure voltages per time, these must lay below the limits of the table in this clause.

5.9: DC current Injection

DC offset at AC Inverter ports must not be greater than 0.5% of the rated O/P current, OR 5mA, whichever is greater. Each phase must be measured separately.

If the Inverter does not incorporate a mains frequency isolating tranformer OR does not have a dedicated external isolation transformer, the limits above must be tested FOR ALL OUPUT CURRENT LEVELS.

NOTE: I think by 'ALL', this referes to the three test voltages outlined in appendix E. Presumably, if the transformer is included, the test need not be carried out. I am not sure of this. Therefore, I recommend to carry out the test in A:E regardless.

Test is the 'D.C current Injection Test' in Appendix E.

5.10: Current balance for three-phase inverters

When the Inverter three phase output is connected the grid, each wire must be within 5% of one another. measurements must be taken at the rated current.

This is tested by simulating a connection to the grid and measuring. There are no further 'test' instructions in the appendix.

If the inverter has a voltage balance mode (6.3.2.4) this clause does not apply.

6.1: All following clauses in section 6. pertain to the grid interactive port of the inverter only, unless otherwise stated.

6.2.1: Demand Response Mode

The inverter must have DRM0 : Operate the disconnection devices. It must respond to this setting within 2s of the setting being activated.

The DRM may be provided by an internal or external component of the Inverter.

While in DRM0 state, the inverter must continue to abide by all of the previous and future clauses (5 - 7).

The tests required to be satisfied are outlined in Appendix I. This involves the construction of numerious circuits and taking measurements which must be within specified bounds.

(Must read all of Appendix I to note what I need to do in preparation)

6.2.2: Interaction with Demand Response Enabling Device.

Summary on DREDs: Given an input 'ripple' detected at the grid, a DRED recognises the ripple and converts it to a signal the Inverter is able to act upon, according to the setting of the DRED for that particular ripple.

The Inverter must have a means of connecting to a DRED. This can either be from a terminal block or a RJ45 socket. Either method must have the I, V, Dielectric and resistance limits specified in the table herein:

I: >= 1.5A

V (r.m.s): >= 125V

Dielectric strength (V r.m.s, 50Hz, 1min): >= 1000V

Insulation Resistance

These are the minimum values the RJ45 socket or terminal block must be rated as being able to withstand.

The DRED will internally short together terminals (terminal block) or pins (RJ45 socket) to simulate the DRMs.

The inverter must not inject more than 30mA (DC or AC) into:

- terminals DRM1/5, DRM2/6, DRM3/7, DRM4/8 for a terminal block
- Pins 1,2,3,4 for an RJ45 socket

The voltage drop over the DRED and associated wiring must not exceed 1.6V when 'nominally shorted' - Me: I think this means when any shorting occurs in line with DRMs

The inverter must not supply more than 34.5V to any DRM connection at any time

If the impedeance between pins 5 and 6 is above 20kOhm, DRM0 must be activated.

The DRED may activate mutliple DRM simultaneously, in which case all modes must be satisfied. If a combination shorts terminals 5 and 6, DRM0 must activate.

If DRM3 or DRM7 are supported, the reactive power set-point must be default set to operate at unity power factor. The reactive power set point must be adjustable up to a minimum of 60% of the Inverters kVA rating.

The inverter may provide a power supply for the DRED. If so, it must be DC and of a voltage less than 34.5V

If an RJ45 socket is used, pins 7 and 8 may be used as the power supply. They must be able to provide a minimum of 0.5A at 6V. If not, the inverter must short together pins 7 and 8.

NOTE: ONLY DRM0 IS REQUIRED, ALL OTHERS ARE OPTIONAL - I CAN IGNORE THEM.

6.3: Power Quality Response Modes

6.3.1:

The inverter may have settings which enable:

- Volt response modes
- Fixed Power Factor or Reactive Power Mode
- Power Response Mode
- Power Rate Limit

IF these settings are adjustable, the setting set must follow all the clauses in this document.

Compliance must be tested by using Appendix I tests.

6.4: Multiple-Mode Inverter Requirements

6.5: Security of operational settings

All demand response and power quality response mode settings must only be

adjustable by use of a tool - note: a password is a tool.

COMPLIANCE WILL BE DETERMINED BY INSPECTION.

7: Protective functions for connection to electrical instillations and grid

7.1:

An automatic disconnection device must activate when connection with the grid is lost. It must prevent injection of energy into the 'point of supply' - presumably this is the PV array. It must prevent islanding.

Disconnection must activate if:

- supply from the grid is lost
- grid goes outside of required parameters
- if DRM0 is asserted

7.2: Automatic disconnection

When activated the ADD must prevent energy flow into the grid. The ADD does not need to disconnect sensing equipment.

The ADD must:

- Be able to withstand an impulse voltage likely to occur at the point of installation, or have an appropriate contact gap.

- With a fault applied to the inverter or the ADD the ADD must disconnect.

The ADD must be able to interupt AT LEAST the rated current.

The settings of the ADD must not exceed the capability of the inverter.

ADD cannot be a semiconductor.

7.3: Active anti-islanding

The ADD must have AT LEAST one method of active anti-islanding. Examples of possible methods are:

- frequency shift
- frequency instability
- power variation
- current injection

All these methods attempt to detect a zero input power from the grid.

The active anti-islanding system must operate the ADD if island detected within 2s.

Compliance with the above is by the test specified in appendix F.

7.4: Passive Anti-islanding Protection

The ADD must include:

- Under/Over voltage protection
- Under/Over frequency protection

If voltage or frequency falls outside the limits set in table 13 herein, the ADD must activate AFTER x and BEFORE y seconds (in table). If conditions fall back inside the limits the ADD need not be activated. The inverter O/P may be stopped independantly before the minimum time.

Test for this is in Appendix G.

7.5: Limits for sustained operation

7.5.2: Sustained operation for voltage variations

Inverter must activate the ADD within 3s if the average voltage for a 10min period falls outside 'V_{nom_max}'. V_nm is between 244 and 258V.

This disconnection must not interfere with the operaion of anti-islanding requirements discussed previously.

The default set point for V_nm in Australia is 255V.

The 10min average value of V must be compared with V_nm AT LEAST every 3s determine when to disconnect

Test is listed in Appendix H.

7.5.3: Sustained operation for frequency variations

7.5.3.1: Response to an increase in frequency

Limits of frequency are between 47Hz and 50.25Hz.

If f is greater than 50.25Hz, the Power output must decrease lineaerly with frequency. until f_stop is reached. f_stop is between 51 and 52Hz.Default set point for f_stop must be 52Hz. There is an equation for the required power output as a function of frequency included herein.

When the grid frequency drops below 50.15Hz or less for at least 60s the power level must be increased at a rate no greater than the 'power rate limit' (specified in clause 6.3.5 - I have not read this yet as it is covered in the Power Response Mode section), until the maximum power output is reached.

Unconstrained power operation may recommence 6min after the frequency drops below and remains below 50.15Hz.

Test is covered in Appendix H.

7.5.3.2: Response to a decrease in Grid Frequency

This requirement applies only to inverters with energy storage.

7.6: Disconnection on External Signal

If an 'external signal' or DRM0 condition is asserted, the ADD must operate within 2s.

'External signal' summary : Me: There is an outline of how to ensure this condition is satisfied in the test, what the signal is I am not sure but

it is sufficient to check compliance.

Test is covered in Appendix I.

7.7: Connection and Reconnection Procedure

Reconnection must only occur after:

- Voltage of the grid has been maintained within the limits of AS60038 for AT LEAST 60s
- Frequency of the grid has been maintained within 47.5Hz and 50.15Hz for at least 60s
- the inverter and the grid are synchronized and in-phase with each other
- No external signal is present or DRM0 asserted requiring disconnection.

After reconnection, the power increase rate must be limited as in clause 6.3.5. Unconstrained power output may resume once the rated power output of the inverter is reached OR the limit of the power supply is reached.

Test is covered in Appendix F and G.

7.8: Security of Protection Settings

Internal settings of the ADD must require the use of a tool for adjustment.

The manufacturer settings of Clause 7.4 must not be adjustable after installation

Compliance will be determined BY INSPECTION.

8: Multiple Inverter Systems

8.2: Current balance across phases

Applies to 3 single phase inverters providing a 3-phase output.

8.3: Grid disconnection

When any inverter disconnects, all inverters must disconnect within 2s after the first.

8.4: Grid connection and reconnection

All the conditions of Clause 7.7 must be met on all phases before ANY reconnection occurs.

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Summary of AS4777.1

Cables:

- Min Capacity is max I out for max V in of Inverter
    - Read inverter info sheet
- Wires on ground must be enclosed
- Wire casing must follow AS2053.1 AND AS61386.1
- Cables must protect against over-current
    - Read AS3000
- If no overcurrent protection in wires mains switch must be a CB rated for fault currents in Inverter and grid supply
    - Read Inverter info sheet
    - Ask SAPN about grid fault currents (AS4777.1:3.4.2)
- CB must be able to:
    - Break rated current of IES
    - Be secured in OPEN position
    - Installed following AS3000
- Must limit voltage rise from grid to Inverter to <2% of grid V.

- PV to Inverter cables must follow AS3008.1 and AS3000
    - Read AS3008.1
- Pos and Neg cables must run together
- Cables between Inverter and PV array must be protected against overcurrent

Connections

- Must use 'pluggable equipment type B' as in IEC60309-1
    - Read IEC60309-1: pluggable equipment type B
- PV connections must follow AS5033
    - Read AS5033

Positioning

- Inverter must be within 3m of main switch board

Reconnection

- Must maintain V within limits of AS60038 for 60secs

Protection

- May need RCD if AS3000 says so
    - Read AS3000
- Isolation device must be between PV and Inverter. Must follow AS3000, AND able to secure in OPEN position

    - Read AS3000

- Inverter must have earth leakage and insulation monitoring

    - Read Inverter info sheet

- If RCD's, they must follow AS5033

    - Read AS5033

- Inverter must be setup following it's IP rating from IEC 60529

    - Read IEC 60529

Manual

- List additional changes enforced by SAPN in the logbook

- Must follow AS3000 and AS4777.1:6

    - Read AS3000

Labelling

- Label cable with "ENERGY SOURCE CABLE","SOLAR"

Mains

- If 5kWA < IES < 30kWA the mains switch must be a 3-pole main switch

Inspection

- Periodic inspection following AS3019

- Read AS3019

Testing

- Perform tests at the end of 4777.1

Office for Technical Regulator

0882265500

21/7

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NEXT STEPS

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1. Read all remaining AS and IEC documents
2. Summarise Inverter requirements and ask retailers about inverters which satisfy these specs. Asking for AS4777.2 compliant inverters may expedite this process.
3. Summarise requirements for cabling and look for cable satisfying these requirements
4. Read AS4777.2 Tests and summarise what testing equipment I need

5. Summarise needed safety specs and use these to design circuit. Using the template provided in AS4777.1 may expedite this process.
6. Search for safety parts (CBs, DREDs, Isolators etc) required and their costs
7. Inquire about cost of electrical licence and timeline to attain
8. Inquire about cost of CEC licence and timeline to attain.

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Called Natalie on 131882 (Consumer and Business Services).
She says: "If the property is my own and I wish to connect to the grid then I won't need a licence - If I am contracting out the work then I will". She recommends I speak to the 'Office for the Technical Regulator' on 0882265500 to ask about the techincal side.

Calling SAPN: Talked to Maddison on _ _ _
Require "accreditation" - overseen by CEC - Need: "Solar Installer Accreditation" - Need: Electrical Licence

4/3 - 2021

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First time taking notes and researching during 2021.

Origin energy replied to my 2020 inquiry. I believe the feed in tariff (FIT) for an alreaday existing solar system is 15 cents per kWh. Based on the link

sent to me in the reply over Facebook messenger:

https://www.originenergy.com.au/solar/feed-in-tariff-rates.html?linkId=94410832#sa

The account the reply was sent to has login details:

Username: joepritchard.solar@gmail.com

Password: Fumanchu42 (I think)

At 15c per kWh the ROI time is 3.5 years with the current simulation. This does not include labour costs at the current time.