1.1 SEPP 33 preliminary risk screening

In addition to the risk assessment above, the SEARs require:

> *a preliminary risk screening in accordance with* State Environmental Planning Policy No. 33 – *Hazardous and Offensive Development and Applying SEPP 33 (DoP, 2011), and if the preliminary risk screening indicates the development is "potentially hazardous", a Preliminary Hazard Analysis (PHA) must be prepared in accordance with Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (DoP, 2011) and Multi-Level Risk Assessment (DoP, 2011).*

The preliminary risk screening is detailed below.

1.1.1 Potentially hazardous industry

A potentially hazardous industry is defined within SEPP 33 as "*a development for the purpose of any industry which, if the development were to operate without employing any measures to reduce or minimise its impact, would pose a significant risk to human health, life or property, or to the biophysical environment*".

DPE have checklists and a risk screening procedure to assist in determining whether a development proposal falls within the definition of potentially hazardous industry.

Lists of potentially hazardous industry

Industries that may fall within SEPP 33 are listed in:

- SEPP 33: Appendix 3 Table: Industries that may be potentially hazardous
- Multi-Level Risk Assessment Guidelines: IAEA Table II Checklist (DPI 2011).

Solar farms are not listed in either checklist.

Screening potentially hazardous industry

The screening procedure is based on the quantity of dangerous goods involved in the development and, in some cases, the distance of these materials from the site boundary.

The following list of hazardous materials and quantities of goods for the development and operation of the Sandigo Solar Farm was estimated based on previous solar farm construction by ESCO Pacific at Ross River, Queensland:

- fire suppression gas (minor numbers of 2.5 kg hand held fire extinguishers)
- diesel – up to 2500 L (operation: up to 2000 L)
- machine oils – 100 L
- lubricants – 100 L
- hydraulic fluid – 100 L
- herbicides – 100 L
- lithium-ion batteries – 240 *Tesla Powerpack 2* units and 40 inverters (in the event a battery storage facility is developed on-site).

If any of the above materials result in a screening threshold being exceeded, the proposed project will be considered potentially hazardous and SEPP 33 will apply.

Under SEPP33 hazardous materials need to be classified according to the National Transport Commission (2017) *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code) (NTC 2017).

The ADG Code lists the following classes of dangerous goods:

- Class 1 Explosives
- Class 2 Gases
- Class 3 Flammable liquids
- Class 4 Flammable solids
- Class 5 Oxidising substances and organic peroxides
- Class 6 Toxic and infectious substances
- Class 7 Radioactive material
- Class 8 Corrosive substances
- Class 9 Miscellaneous dangerous substances and articles, including environmentally hazardous substances.

The ADG Code classes were assigned to the materials identified as dangerous goods that are likely to be used on site. Materials identified as dangerous goods for the Sandigo Solar Farm project include:

- fire suppression gas
- fuels and oils
- herbicides
- lithium-ion batteries.

Tables 1.1 and 1.2 present the screening threshold levels from SEPP 33 above which the dangerous goods are considered potentially hazardous and requiring further assessment. Table 1.1 covers dangerous goods storage and Table 1.2 dangerous goods transportation. The tables include dangerous goods class, storage and transport thresholds, proposed storage and transportation, and an assessment of whether the SEPP is exceeded.

Transport, Storage and Handling

The ADG Code requires dangerous goods to be carried in a secure, safe and environmentally controlled manner. All hazardous materials will be stored and transported in bunded containment. The ADG code also specifies ‘special provisions’ and ‘packing instructions’ applying to the transportation of lithium-ion batteries.

All Dangerous goods (except Lithium-ion batteries) will be appropriately segregated and stored within bunded areas of the maintenance yard located centrally on the solar farm. Lithium-ion battery units will be stored in separate enclosure next to the maintenance yard. The distance from maintenance yard and battery enclosure to the nearest development site boundary (located to the west) would be 300 m. The maintenance yard would be located approximately 1500 m southeast of the nearest residence (landowner residence), 800 m south of Sturt highway and 1000 m south of Sandy Creek.

Lithium-ion batteries

It is noted that although DG Class 9 materials are excluded from the screening test, the hazards related to these materials should be considered as detailed in *Applying SEPP 33 Guidelines.* Further information follows in the next section Battery Storage.

Table 1.1 Dangerous goods and SEPP 33 storage threshold

Hazardous material	Dangerous goods class	SEPP 33 storage threshold	Project storage	Exceed SEPP
Fire suppression gas	2.2	Not applicable		No
Fuels and oils	3 PGII	5 tonne	<2.8 tonne[1] <2.0 tonne[2]	No
Herbicides	6.1 PGII	2.5 tonne	0.1 tonne[2]	No
Lithium-ion battery units	9	Not applicable	240	No

[1] during construction
[2] during operation

Table 1.2 SEPP 33 transport threshold

Hazardous material	Dangerous goods class	SEPP 33 transport threshold		Project transport requirements		Exceed SEPP
		Movements	Quantities	Movements	Quantities	
Fire suppression gas	2.2	Not applicable				No
Fuels and oils	3 PGII	>750/year cumulative >45/week	3-10 tonne	52/year cumulative, 1/week[1] 12/year cumulative, 1/month[2]	<2.5 tonne[1] <2.0 tonne[2]	No
Herbicides	6.1 PGII	Yes	1-3 tonne	twice a year[2]	<0.1 tonne[2]	No
Lithium-ion battery units	9	>1000/year cumulative >60/week	No limit	20/year in total[1]	12[1]	No

[1] during construction
[2] during operation

Battery storage

The installation of the battery storage will be undertaken in accordance with the current regulations and guidelines for battery installation. However, this is a new and evolving area of regulation and if further regulations, standards or guidelines (e.g. release of final AS/NZ 5139 *Safety of battery systems for use in inverter energy systems*) become available, the proposed battery installation shall be checked and modified for consistency with these new reference documents and modified as required to conform with best practice.

The level of risk arising from battery storage depends on the quantity and type of batteries, the storage arrangements and proposed control measures (including fire prevention, protection and mitigation measures). The following information provides details on the batteries and storage arrangements to qualify the extent and the magnitude of the risks associated with the proposed battery storage[1]:

- total capacity of the battery storage
- distance from the battery storage location to the nearest residence and to the office building
- details on storage arrangements, including minimum separation distances between the containers
- hazards arising from the storage of lithium-ion batteries should be identified and appropriate safeguards should be listed
- details on the proposed control measures to minimise the risks.

Total capacity of the battery storage

The proposed battery storage system for the Sandigo Solar Farm is a Teslar *Powerpack 2* system developed for use in commercial, industrial, or utility energy storage applications for various on-grid applications, as well as microgrid applications to support backup and islanded systems (Tesla 2017).

The Tesla *Powerpack 2* system is a pre-assembled integrated battery energy storage systems (BESS) which includes the battery system, cabling, switchgear, power conversion equipment and auxiliary equipment.

ESCO Pacific proposes to install up to 240 Tesla *Powerpack 2* lithium-ion batteries units and 40 inverters. This will provide a total capacity of 20MW and 40MWh.

Distance from the battery storage location to the nearest residence and to the office building

Lithium-ion battery units will be stored in separate battery enclosure (50 m x 100 m) next to the maintenance yard located centrally in the solar farm. The distance from the battery storage enclosure to the nearest development site boundary would be 300 m. As outlined above, the battery storage enclosure would be located approximately 1500 m southeast of the nearest residence (landowner residence), 800 m south of Sturt highway and 1000 m south of Sandy Creek.

The office and workshop are located within the maintenance yard and would be at least 20 m from the battery enclosure.

Details on storage arrangements, including minimum separation distances between the containers

The following, listed in *Battery Energy Storage Systems - A guide for Electrical Contractors* (DoC 2017), will be considered for appropriate location of battery storage:

- building codes applicable to batteries (national and local), changes to floor loadings and National Construction Code requirements for battery installations

[1] Email correspondence from Lilia Donkova, NSW Department of Planning and Environment, to ESCO Pacific on 28 March 2018.

- location complies with the manufacturer's recommendations to protect the system from weather and extreme heat, light and temperature
- room or enclosure must be suitably ventilated for the location and the type of BESS
- the enclosure must be capable of containing any electrolyte spills
- adequately fire-rated walls are used to avoid or delay the spread of fire
- suitable means of access/egress to the area is provided during installation and for maintenance work
- the enclosure provides adequate mechanical protection to the BESS.

Separation of units and inverters

Photo 1.1 Standard arrangement of a storage bank of Tesla Powerpack units and inverter (Tesla 2017a)

The Tesla *Powerpack 2 System* consists of self-contained lithium-ion battery units installed in a modular system in accordance with the Tesla (2017a) manufacturers instructions, as shown Photo 1.1 and in Table 1.3.

Table 1.3 Minimum clearances between Powerpack units and inverters (Tesla 2017a)

Equipment	Front	Sides	Back	Top
Powerpack Unit	1830 mm	105 mm	30 mm [1]	1524 mm for combustible materials or 610 mm for minimum 1-hr fire rated materials
Powerpack Inverter	1830 mm [2]	100 mm	100 mm	915 mm [3]

Exceptions are approved for the clearances, as follows:

[1] *The back to back spacing of the Powerpack Units should be measured from the body of the enclosure. If the Powerpack Unit anchor template is not used, use a spacer to ensure that 16 mm of clearance is provided at the top of the units for seismic deflection.*

[2] *The clearance stated above is a minimum and should be increased to meet electrical building codes as necessary.*

[3] *If clearance to the rear of the inverter is at least 915 mm, top clearance can be reduced to 610 mm.*

NOTE: The required tolerance for the spacing between Powerpack Unit sides is +/- 6.4 mm (Tesla 2017a).

Access and egress clearances

The Australian Battery Guide details the egress and access requirements for a battery enclosure to provide access to the batteries with sufficient space for safe installation, testing and maintenance and suggests at least 1200 mm of space for battery cells / mono-blocks that weigh more than 150 kg (ESC 2016).

The Powerpack System will be installed in an outdoor enclosed area that must provide a minimum 1.22 m wide access around the sides of the equipment and 1.83 m access to the front and of each Powerpack Unit (Figure 1.1). This access is required for service cart access and is required to be level (maximum 5% cross slope) as detailed in the *Tesla Powerpack System O&M Manual* (Tesla 2017a).

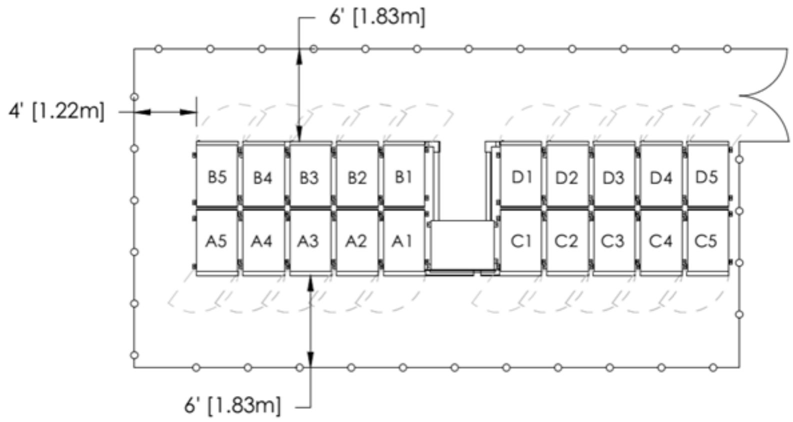

Figure 1.1 Battery unit system

Within the maintenance yard, security fencing for the battery enclosure will ensure that no walls or other structures are built that could interfere with any component's door opening fully (Tesla 2017a).

The hazards arising from the storage of lithium-ion batteries should be identified and appropriate safeguards should be listed

Batteries can be a serious safety risk for occupants and installers if incorrectly installed and operated, potentially leading to electric shock, fire, flash burns, explosion or exposure to hazardous chemicals and released gases (DoC 2017).

The Clean Energy Council (2017) prepared the *Battery install guidelines for accredited installers*. These guidelines represent latest industry best practice for the installation of battery systems and pre-assembled BESS.

The guidelines note there are numerous hazards associated with battery systems/pre-assembled BESS, such as:

- electrical
- energy
- fire
- chemical
- explosive gas
- mechanical.

Where a hazard is identified, as per the chemistry and overall battery system/BESS design, the guidelines state that risk reduction methods shall be applied to eliminate or reduce these risks to protect persons, property and livestock from:

- electric shock
- fire
- physical injury (CEC 2017).

Electrical hazard

The electrical risks associated with battery systems are dependent on the voltage of the battery system and other connected equipment – such as earthing, protection devices, etc. The degree of separation of the relevant battery port from the grid or other energy source and the prospective short circuit/ fault current may be significant in a battery system. This condition occurs where the impedance between conductors is almost zero and overcurrent protection does not operate (CEC 2017).

Shutting off power to the Tesla Powerpack System does not de-energize the battery, and thus a shock hazard may still be present. Electric shock could occur when touching live components. Servicing instructions are for use by qualified personnel only (Tesla 2017a).

The mishandling of BESS components could result in an electrical shock or personal injury.

Energy hazard

An energy, or arc flash, hazard occurs where there is a release of energy caused by electrified conductors when there is insufficient isolation or insulation to withstand the applied voltage. Under such conditions, electrical energy is transferred into other forms of energy including heat, light and sound. Such a hazard may occur under the following scenarios:

- accidental contact between battery terminals with a conductive tool – such as an uninsulated socket wrench, spanner, etc.
- a dead short within connected PCEs
- a build-up of conductive material across conductors – such as fluid, metal shavings, etc.
- damage to cable insulation, resulting in electrical conductivity between copper conductors (CEC 2017).

Lithium-ion batteries are a source of energy and therefore short circuiting, puncturing, incinerating, crushing, immersing, forcing discharge or exposing to temperatures above the declared operating temperature range of the product could result in a release of energy causing an electrical shock, fire or personal injury (Tesla 2017b).

Fire hazard

A fire hazard may be present where the battery system chemistry is lithium. Factors that may result in fire include:

- low ambient pressure
- overheating
- vibration
- shock
- external short circuit
- impact
- overcharge
- forced discharge (CEC 2017).

Powerpack systems can withstand temperatures of -40°C to 60°C for up to 24 hours, however exposure of elevated temperatures can drive battery cells into thermal runaway and result in a fire. An internal or external short circuit can cause significant overheating and provide an ignition source resulting in fire, including surrounding materials or materials within the cell or battery. Severe mechanical damaged (e.g. severe crushing) can cause a small quantity of electrolyte (up to approximately 1 g) to leak out of a cell. Evaporated electrolyte is flammable (Tesla 2017b).

The mishandling of BESS components could result in a fire or personal injury.

Chemical hazard

There are many types of chemical hazards that a battery system may represent. Typically, stored chemical energy in the form of a fluid or gel electrolyte is the source of a chemical hazard. A chemical hazard may occur:

- under normal operating conditions (e.g. venting of hydrogen gas when charging)
- under fault or abuse conditions, including:
  - mechanical (e.g. impact, puncture, etc.)
  - thermal (e.g. in excess of specified operating conditions)
  - electrical (e.g. forced discharge) (CEC 2017).

Tesla lithium-ion batteries do not contain free liquid electrolyte and do not pose a liquid release hazard (Tesla 2017a).

Under normal conditions of use, the electrode materials and electrolyte they contain are not exposed, provided the battery integrity is maintained and seals remain intact. Risk of exposure may occur only in cases of abuse (mechanical, thermal, electrical). Severe mechanical damaged (e.g. severe crushing) can cause a small quantity of electrolyte (up to approximately 1 g) to leak out of a cell and evaporated electrolyte is flammable (Tesla 2017b).

The release of the chemical electrolyte could result in a fire or personal injury.

Explosive gas hazard

Under certain conditions, some battery systems and pre-assembled BESS emit explosive gas which represents a hazard where an ignition source is present.
Ignition sources may include:

- battery system isolation and overcurrent devices
- switches internal to electrical components
- fans
- motors
- general electrical switches (e.g. light & power) (CEC 2017).

Lithium-ion batteries do not produce any exhaust gases during normal operation, but they can produce flammable and toxic gases if there is a fault (DoC 2017).

Severe mechanical damaged (e.g. severe crushing) can cause a small quantity of electrolyte (up to approximately 1 g) to leak out of a cell and evaporated electrolyte is flammable (Tesla 2017b).

The release of the explosive gas electrolyte could result in a fire or personal injury.

Details on the proposed control measures to minimise the risks

The installation of the Tesla *Powerwall 2 system* will be in accordance with the current regulations and guidelines for battery installation to help avoid and mitigate battery hazard impacts:

- The Clean Energy Council (2017) provides guidelines for battery installation – *Battery install guidelines for accredited installers* (CEC 2017).
- WA Department of Commerce has released a guide for electrical contractors in relation to battery storage systems – *Battery Energy Storage Systems - A guide for Electrical Contractors* (DoC 2017).

Note: Standards Australia has developed a draft standard (AS/NZS 5139) for battery installations which has been released for public submissions but a final release date has not been indicated.

Electrical and Energy hazard risk reduction

A *Powerpack 2* unit (as shown in Photo 1.2), even in a normally discharged condition, is likely to contain substantial electrical charge and can cause injury or death if mishandled (Tesla 2017a).

To reduce the risk of Electrical and Energy Hazards:

- Access to the battery enclosure will be restricted to authorized personnel only.
- Battery installation will only be undertaken by an accredited installer (CEC 2017).
- The *Powerpack 2* System will be installed in accordance with the manufactures instructions Tesla (2017a).
- All access and servicing will be performed by qualified personnel only (Tesla 2017a).
- The *Powerpack 2 u*nit door includes two latches that require a special tool to unlock, limiting access to authorized personnel only (Tesla 2017a).
- Operating alarm and shutdown response systems will be installed.
- An emergency response plan including instructions for responding to incidents related to the battery storage will be developed.
- Personal protective equipment will be used, spill kits provided and safe work procedures followed when handling, repairing, maintaining, installing and inspecting battery systems (CEC 2017).
- First aid materials and training will be provided to staff.

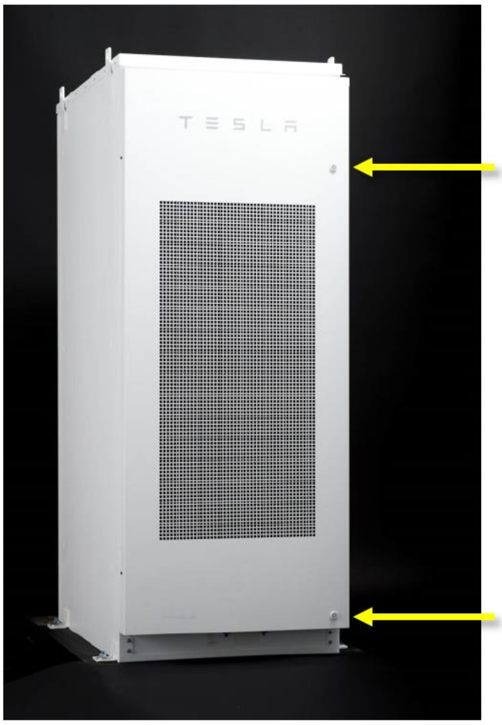

Photo 1.2 Powerpack unit security latches (Tesla 2017a)

Fire hazard risk reduction

Elevated temperatures can result in reduced battery service life and exposure of elevated temperatures can drive battery cells into thermal runaway and result in a fire. An internal or external short circuit can cause significant overheating and provide an ignition source resulting in fire, including surrounding materials or materials within the cell or battery (Tesla 2017b).

Gaseous agents such as CO_2 or Halon, or dry chemical suppressants may temporarily suppress flaming of lithium-ion battery packs, but they will not cool lithium-ion batteries and will not limit the propagation of cell thermal runaway reactions (Tesla 2017b).

Tesla recommends that copious volumes of water be used to fight a fire involving Tesla Energy Products. Virtually all fires involving lithium-ion batteries can be controlled with water. To date, water has been found to be the most effective agent for controlling lithium-ion battery fires. Water will suppress flames and can cool cells, limiting propagation of thermal runaway reactions. If water is used, electrolysis of water (splitting of water into hydrogen and oxygen) may contribute to the flammable gas mixture formed by venting cells, burning plastic, and burning of other combustibles (Tesla 2017b).

To reduce the risk of fire hazard:

- The battery enclosure will be located to maximise distances to sensitive receivers (residences, public) and from external hazards (bushfire, vehicles).
- The battery enclosure would including gravel surfacing to minimise the risk of fire escaping from the facility and the risk of external fire affecting the facility (Tesla 2017a).
- All access and servicing will be performed by qualified personnel only (Tesla 2017a).
- Battery installation will only be undertaken by an accredited installer (CEC 2017).
- The *Powerpack 2* system will be installed in accordance with the manufactures instructions Tesla (2017a).
- The *Powerpack 2* system include sealed thermal management systems containing coolants and refrigerants (Tesla 2017b).
- An operating alarm and shutdown response system will be installed.
- An emergency response plan, including instructions for responding to incidents related to the battery storage, will be developed.
- An external fire detection system will be installed.
- A fire water sprinkler system will be installed and maintained.
- Communication with local fire services will be established and maintained.
- Personal protective equipment will be used, spill kits provided and safe work procedures when handling, repairing, maintaining, installing and inspecting battery systems (CEC 2017).
- Fire response tools and training will be provided to staff.

<u>Chemical risk reduction</u>

In case of an electrolyte leak, the following protective equipment is recommended: an air purifying respirator with organic vapor/acid gas cartridges, safety goggles or a full-face respirator, and safety gloves (Butyl rubber or laminated film). Protective clothing should be worn. Use a dry absorbent material to clean up a spill (Tesla 2017b).

To reduce the risk of chemical hazard:

- A battery storage enclosure will be developed, restricting access to vehicles and personnel.
- Units will be bunded to retain harmful substances in the event of spillage and/ or discharge.
- An emergency response plan including instructions for responding to incidents related to the battery storage will be developed.
- Personal protective equipment will be used, spill kits provided and safe work procedures when handling, repairing, maintaining, installing and inspecting battery systems (CEC 2017).
- First aid, spill response and fire response materials and training will be provided to staff.

<u>Explosive Gas risk reduction</u>

Leaked electrolyte is colourless and characterized by a sweet odour. If an odour is obvious, evacuate or clear the surrounding area and allow area to ventilate. If a liquid is observed that is suspected electrolyte, ventilate the area and avoid contact with the liquid (Tesla 2017b).

Gases or smoke exiting a lithium-ion battery pack are likely flammable and could ignite unexpectedly as the condition that led to cell venting may also cause ignition of the vent gases. A venting Tesla Energy Product should only be approached with extreme caution by trained first responders equipped with appropriate personal protective equipment (PPE) (Tesla 2017b).

To reduce the risk of explosive gas hazard:

- An outdoor battery enclosure will be constructed, providing clearance from and/ or elimination of ignition sources, allowing for full ventilation, and restricting access to vehicles and personnel. (CEC 2017)
- An emergency response plan, including instructions for responding to incidents related to the battery storage, will be developed.
- Personal protective equipment will be used, spill kits provided and safe work procedures when handling, repairing, maintaining, installing and inspecting battery systems (CEC 2017).
- First aid, spill response and fire response materials and training will be provided to staff.

Assessment

Based on the quantities of dangerous goods required for solar farms, none of the screening threshold levels were exceeded and the project is therefore considered not potentially hazardous. Accordingly, SEPP 33 does not apply and a PHA is not required.

The major hazard associated with lithium-ion battery technologies is fire, as a result of the flammability of the substances used in the battery (Recharge 2013). Fire risks associated with lithium-ion batteries are also discussed in Section **Error! Reference source not found.**.

1.1.2 Potentially offensive industry

A potentially offensive industry is defined under SEPP 33 as:

> "*development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment."*

Identifying potentially offensive industry

The process for identifying a potentially offensive industry is based on whether a pollution control license or approval is required for the development and/or if the development causes offence having regard to the sensitivity of the receiving environment.

In the case of the Sandigo Solar Farm:

- A pollution control licence or approval is not required.
- This EIS (specifically Chapter **Error! Reference source not found.**) assesses the impact on the environment.

Assessment

Based on the identification process and the outcomes of this EIS, the project is not considered to be potentially offensive and therefore SEPP 33 does not apply.

References

CEC (2017). *Battery installation guidelines for accredited installers*. Clean Energy Council. 15 August 2017.

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