UN Security Communication System (SCS) Standards

Electrical and backup power systems for UN Security Communication Systems (SCS) technical manual

Version 1.4 | May 2024

Telecommunications Security Standards {TESS+}
https://tessplus.org
Direct any queries to: tess@wfp.org

Document revisions

Version	Date	Description
1.4	22 MAY 2024	First released version

Table of Contents

Description

The United Nations (UN) Security Communications System (SCS) depends on a reliable and stable power supply for the different elements of the SCS, including short range communications, long range communication and the Security Operations Centre (SOC), to remain operational. The UN SCS must also be capable of operating when primary power sources become unavailable for any reason. It is important to remember that the ultimate purpose of the SCS is for the SOC or local security point of contact, to be able to contact (and be contactable by) all United Nations Security Management System (UNSMS) personnel within each operational area at any given time.

Purpose

The goal of this document is to provide practical guidance on the design and deployment of redundant power systems for the SCS, including the identification, implementation, operation, and support of electrical and backup power needs to ensure maximum up-time for the UN SCS, including the SOC.

Power redundancy for SCS equipment

Including 'redundancy' as a design principle is a key foundation for uninterrupted operations of the UN SCS. This includes redundancy in the systems that provide power to the SCS and SOC equipment. Ensuring a constant and reliable power supply is vital, given the important role of security communications in both day-to-day and emergency situations. Power redundancy guarantees that even in the face of unexpected power outages or technical failures, vital communication channels can remain active and operational.

Redundancy in the context of power supply entails a primary power source and at least one backup power source that facilitates operations when the primary becomes unavailable. The primary power source is typically the main power from the local electricity grid, although for remote locations the primary can be a generator or even a solar panel system. The backup power source(s) should automatically provide the necessary power to the SCS equipment when the primary power source is unavailable, and the backup should remain active until the primary comes back online. In a UN office environment, the primary is typically the local mains power grid where the backup is provided by a generator. However, as there is a time gap between loss of grid power and when the generator comes online, a battery solution is required to ensure uninterrupted supply.

Security communications equipment is the backbone of real-time information exchange and decision-making processes. UN SCS equipment encompasses a range of technologies, including VHF/UHF radio, satellite systems, and mobile telephony. UN SCS equipment can be divided into three sections:

1. Infrastructure equipment:

Radio repeater equipment:

VHF/UHF repeaters are commonly utilized to expand the coverage of VHF/UHF radio networks within operational areas. VHF/UHF repeaters can be found in UN offices/compounds, town buildings, top hills, and other higher altitude locations.

Radio repeater power solutions, depending on where they are located, can be powered by a few different solutions as follows:

UN offices/compounds: These locations are primarily powered from the local grid (mains power) and typically have a backup generator in place for redundant power supply. However, a battery backup solution is required in this scenario to cater for, for example, the time lag between the local grid power becoming unavailable and generator power coming online. The battery backup can come in the form of a common UPS battery bank for all SCS related equipment, or dedicated battery backups for a particular equipment.

Third party commercial sites: These sites usually offer redundant power supplies as part of the service, and this should be validated during the site contract negotiation phase. Assuming that is the case, an adequate battery backup solution is still required to ensure uninterrupted supply when site power becomes unavailable. The size and type of the battery backup will depend on several factors. If the site has reliable power (e.g. mobile network operator site) and is located close to UNSMS technical support resources, a simple battery only backup could be sufficient. However, if power at the site is less reliable, a more comprehensive battery backup with an independent charging system (e.g. solar/wind) might be required.

Remote sites: These sites may have unreliable power supply and may not be connected to the mains grid power at all. In such a scenario, a primary power source needs to be deployed. This can be an appropriately designed solar charging system and a battery bank with enough capacity to keep the installation in operation based on the backup power runtime of the power system deployed. The charging system can also include the mains grid (if available), wind power or a generator.

2. Network and interlinking equipment:

Network and interlinking equipment serve the purpose of connecting multiple radio repeaters to extend coverage beyond the reach that an individual standalone repeater can provide. Network and interlinking equipment encompass a range of devices such as ROIP (Radio Over Internet Protocol) devices, switches, and microwave links. They facilitate the seamless integration and communication between multiple repeaters, ensuring a broader coverage area and enhancing the overall effectiveness of the communication network.

ROIP devices enable communication over the internet, breaking down geographical barriers and connecting repeaters over vast distances. Switches play a pivotal role in managing and directing communication traffic efficiently within the network. Microwave links provide a high-speed and reliable connection between repeaters, ensuring data transfer with minimal latency.

3. SOC and field equipment:

Remote SOC (RSOC) equipment: A combination of VHF/UHF base stations, ROIP devices, switches and routers that provide remote monitoring and control of VHF/UHF radio networks in multiple remote operational areas. In an RSOC solution, the network and interlinking devices are strategically placed within the SOC, coexisting with the base stations utilized by SOC assistants as dispatcher devices. These interconnected devices draw power from the same source that supplies the radio equipment within the SOC, typically situated in UN compounds. It is imperative for these locations to possess a reliable backup system, whether in the form of generators, building grid UPSs, or solar backup power. This backup infrastructure is essential to ensure the uninterrupted operation of the RSOC solution, guaranteeing continuous communication capabilities. In the field, the RSOC equipment is strategically positioned at locations where repeaters are in operation. This could encompass the UN compounds, and these field RSOC components can establish wireless or wired connections to the nearest internet point. Typically found within UN compounds, these internet points rely on a combination of power solutions, including generators, UPSs, and/or solar panels. It is highly preferable for these installations to incorporate an independent backup power source, ensuring the resilience of the RSOC system even in the event of a power outage or disruption. This comprehensive approach to power redundancy contributes to the robustness and reliability of the RSOC solution in diverse operational environments.

Computers (SOC): Used in the SOC for daily operations and required to operate SCS applications such as bulk SMS systems, email etc. UPSs play a crucial role in providing backup power for SOC computers, ensuring uninterrupted functionality. Often the SOC computers are laptops which have a built-in battery; laptops are recommended for this reason.

VHF/UHF base station radios (SOC): SOCs which are usually located in one of the UN compounds, have base stations that play a crucial role in short range radio communication, especially in situations where reliable and efficient communication is essential. base stations serve as the central communication hub for coordinating activities and relaying information operated by SOC assistants in which it enables quick and effective communication during critical situations.

Base stations typically powered by 12-volts power supplies that are connected to the main electrical supply of the facility. This ensures a consistent and reliable power source for continuous communication operations. The base station draws power from the electrical grid to operate its transceiver and other devices in the SOC, the backup power size for the SOC depends on the number of radios monitoring the system, The battery backup can come in the form of a common battery bank for all SCS related equipment, or a dedicated battery backup for this equipment.

VHF/UHF portable (handheld) radios: Portable devices carried by users offer flexibility of usage while on the move. These devices operate using removable batteries and require specific chargers tailored to the manufacturer and handheld model. It is essential to ensure that the batteries are consistently fully charged and replaced when needed. The charging dock is compatible with facility AC power, and for personnel on the move, having an extra battery and a vehicle charger proves to be a practical choice, ensuring continuous functionality even in dynamic operational environments.

VHF/UHF mobile radios: Mobile radio devices are installed in vehicles to allow passengers to use the radio on the move and operate with a much higher power than handheld radios. The only way for a mobile radio to operate is to use the vehicle battery.

SAT phones with docking stations (SOC): Long-range communication devices that use satellites to provide voice and SMS communication. As per UN SCS guidance, SAT phones in the SOC should be deployed with individual docking stations and external antennas to allow for indoor use of the satellite phone. SAT phones have a removable battery (like mobile phones) which is recharged when docked. A UPS is the optimal power backup solution during power outages. In addition, a spare battery for individual SAT phones should be kept in the SOC inventory as satellite phone batteries can become faulty and do degrade over time.

SAT phones with docking station (vehicle): Is similar the SOC satellite phone with the difference that the docking station is installed in a vehicle and connected to the vehicle battery for recharging the satellite phone battery when docked. The docking station also allows for reliable in-vehicle use with the external antenna. The device can also be used without a docking station for temporary use- a socket charger can be used to charge the device, and an external magnetic antenna can also be used to enable in-vehicle to use in those vehicles without a docking station.

Mobile phones (SOC): Mobile phone networks are commonly the primary SCS. Mobile phones have a battery that is either built-in or removable and can be recharged using a phone charger that is compatible with the mobile phone device or portable power banks. It is recommended that the SOC maintains some portable power banks (that are kept charged) to recharge mobile phones if the primary power is down or an evacuation is required. Compatible charging cables for mobile phone devices should also be readily accessible in the SOC.

Backup power solutions

Various power backup solutions can be employed to provide power to the SCS equipment when the primary power source is unavailable. A combination of backup power equipment can be tailored to support one or more SCS connectivity devices effectively.

Generators:
Generators serve as a main or backup power source, providing a reliable power option during electricity outages or in locations where a consistent power supply is challenging. Generators function by converting mechanical energy, usually derived from fuel combustion or other sources, into electrical energy. Commonly used fuels include gasoline, diesel, natural gas, or propane.

One key advantage of generators as backup power is their ability to quickly become operational when the main power source fails. This ensures continuity in critical operations for UN compounds and other essential facilities. Generators are available in various sizes and capacities to meet the needs of different applications.

Portable generators are convenient for temporary power needs, such as when used in group of UN staff in temporary field visits e.g. Visiting beneficiary camps where staff telecommute every day and need portable power source, while standby generators are permanently installed and automatically activate when they detect a power outage. Standby generators are commonly employed in residences and businesses where uninterrupted power is important.

While generators provide a reliable backup, it is important to consider factors such as fuel availability, maintenance requirements, and noise levels. Regular maintenance is essential to ensure their readiness when needed. Additionally, advancements in technology have led to the development of more environmentally friendly options, such as inverter generators and models that can be integrated into solar power systems.

Rechargeable deep-cycle batteries:
Deep-cycle batteries are designed to be repeatedly discharged and recharged (ie. cycled). They are commonly used in applications such as golf carts, recreational vehicles (RVs), and solar power systems. Regular maintenance is essential to maximize the life of deep-cycle batteries. Deep-cycle batteries may look like car batteries to unfamiliar people, but they are different. A deep-cycle battery is a battery designed to provide sustained power over a long period of time and run reliably until it is 80% discharged or more, at which point it needs to be recharged. It is important to note that although deep-cycle batteries can be discharged up to 80%, most manufacturers recommend not discharging below 45% to extend the life of the battery.

Figure 1: Rechargeable battery bank

There are different types of deep cycle batteries, such as:

Gel batteries: Also known as gel cell batteries, are a type of valve-regulated lead-acid (VRLA) battery. These batteries utilise a jellified electrolyte, where sulfuric acid is mixed with silica fume, turning the liquid into a gel-like substance. The gel electrolyte eliminates the risk of spills, making gel batteries maintenance-free and suitable for applications where traditional flooded lead-acid batteries may not be practical.

Absorbed Glass Mat (AGM) batteries: Another sealed type where the glass mat stores electrolytes evenly across the battery resulting in better performance and charging over long periods of time.

Lithium-Ion (Li-ion) batteries: The most expensive of all deep cycle batteries, lighter in weight, have a longer lifespan, and can be discharged more deeply without damage. Shipping costs are higher due to Li-ion having specific handling needs due to safety and fire hazards.

Lithium-iron-Phosphate (LiFePO4) batteries: Having a lower energy density than Li-ion, however a longer charge/discharge cycle lifetime. It also has a more stable chemical and thermal chemistry and is not considered hazardous. Unlike Li-ion it has no thermal runaway and is safe when fully charged. LiFePO4 has a longer life cycle and lower cost than Li-ion.

Solar panel systems:

Solar panels (also known as photo-voltaic "PV" panels) are devices that convert light from the sun into electricity that can be used to power electrical loads. Solar panel systems are a combination of solar panel arrays, power controller and batteries connected to provide a particular power output. Solar panels are much cheaper, lighter in weight than generators and need less time in maintenance over the long term. This makes solar panels cost efficient and effective when used for supplying power to the SCS.

Figure 2: Solar panel arrays

Solar array power production is measured in Watts (W). The peak power produced by solar panels is during the middle of the day when the sun is the strongest. The peak times can vary depending on the orientation and tilt of your panels but also the location of the panels, weather conditions, and the time of year.

Uninterruptible Power Supply (UPS):

Uninterruptible Power Supplies (UPS) provide a battery backup when the electrical power fails or drops to an unacceptable voltage level. Small UPS systems provide power for a few minutes; enough to safely shut down a computer, while larger UPS systems have enough battery capacity to keep systems working for several hours. A UPS can deliver immediate and continuous power in an outage between switching to an alternate backup source such as a generator. UPS systems typically provide surge suppression and may provide voltage regulation.

Figure 3: Uninterruptible power supplies (UPS)

Power inverters and DC chargers:

Rechargeable batteries are essential sources of direct current (DC), but when there is a requirement for alternating current (AC) power, a pivotal component comes into play – the DC-to-AC power inverter. This electrical device serves the crucial function of converting DC input from rechargeable batteries into AC output. Power inverters find widespread application in electronic devices that necessitate AC supply, requiring equipment such as AC adapters specifically tailored to a designated frequency, such as 50Hz or 60Hz.

The versatility of power inverters lies in their ability to facilitate the seamless transition between DC and AC power, enabling compatibility with various electronic gadgets and systems. Each power inverter is meticulously designed with unique characteristics suited to diverse applications. These characteristics may include power rating, waveform type, and efficiency, among others. It is crucial to adhere to the specified maximum load capacity of a power inverter, as exceeding this limit can compromise its performance and longevity.

In essence, power inverters play a vital role in ensuring the compatibility and functionality of electronic devices that rely on rechargeable batteries for their power source. Their adaptability and nuanced design make them indispensable components in the realm of electrical engineering and modern technology.

Figure 4: DC to AC converter

Figure 5: AC to DC battery charger

Backup power consumption and runtime matrix

As previously stated, certain countries or areas may face periodic mains grid power outages and unavailability. Local teams determine the duration of these outages based on their experience and regular monitoring practices, spanning daily, weekly, or monthly periods. This information is vital in establishing the specifications for constructing a resilient backup power system to ensure a consistent and stable power supply. Once the anticipated duration of power outages and the type and wattage of the SCS equipment to be connected to the backup supply is determined (i.e., the load), the backup power system can be tailored accordingly. The ultimate design may involve a singular type of backup power equipment or a blend of solar systems, batteries, and UPS, based on the specific requirements and load considerations. A description of power consumption for various SCS devices is stated in **Annex A**, which also provides general knowledge of calculating the estimated consumption and power backup runtime for different solutions.

In practical terms, the information is translated into a calculation chart matrix that outlines the recommended backup power solutions for electricity outages lasting 6 hours, 12 hours, and 24 hours, specifically tailored for each device within the SCS located in the SOC. This matrix is available as **Annex B**.

Examples from the field

Figure 6: A solar powered VHF repeater site, with Power inverter connected to batteries, solar panels feeding SCS equipment in the rack

Figure 7: Solar panels and a battery hut outside a large SOC

Figure 8: Battery connections to a solar panel controller

Figure 9: Radio base stations in the SOC connected to back-up batteries stored in boxes

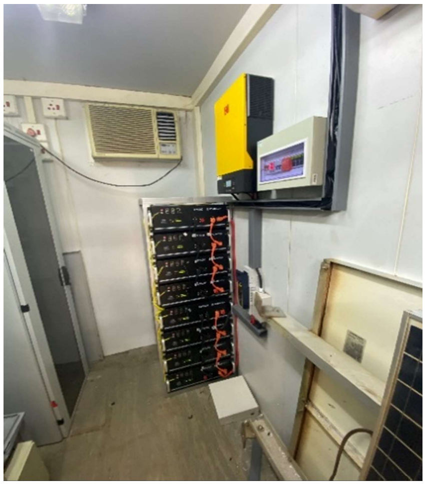

Figure 10: Solar panel inverter with UPS and batteries for a VHF repeater site

Conclusion

Electrical and power backup systems play a critical role in a world that relies heavily on technology. Providing an uninterrupted power supply, even in the most constrained environments, is essential to ensure that communication systems can always function. This guidance document highlights the importance of efficient power management and redundancy of the power solution for the UN SCS.

One of the key metrics in evaluating the effectiveness of backup power systems is the backup power runtime. This measure is the duration that backup power can be sustained and is crucial for planning and preparedness purposes. The required backup power runtime must be carefully considered when designing the backup power system to guarantee continuous operation of SCS equipment and minimise service disruptions.

A variety of backup power solutions are available ranging from generators to renewable energy sources. These backup systems serve as a safeguard, ensuring that essential operations can continue during power failures. By understanding power consumption patterns of deployed systems and investing in backup power solutions with extended power runtimes, we can provide a more reliable security communications system to the UNSMS and NGOs.

Annex A – Power consumption of selected SCS equipment

The power consumption of a device typically signifies the energy it utilizes to function and is measured in Watt-hours (Wh). This measurement denotes one Watt of power being utilized for one hour of time.

To calculate the power needed for any equipment, the input voltage used and current drain during operation must be known (usually found in the specifications for the device).

Devices have varying power source needs. Some devices run on standard 110-220 V AC found in mains electricity and generators, while others require 12 V DC. Achieving the latter involves connecting the device directly to a DC power source, such as a battery or a power supply equipped with a transformer.

The equation for power consumed is:

Power(W) = Voltage(V) x Current(A)

If a unit of power and time are not specified in Watts and number of hours, respectively, then they must be converted to those units before determining energy in Watt-hours.

Energy (Wh) = Power (Watt) x Time(h)

Suppose a 60Watt light bulb burns for 3 hours. Then power = 60 and t = 3, so the total energy E in Watt-hours is:

E = P*t = 60 x 3 = 180 Wh

Watt-hours are useful in a different way. With a battery that displays its rating as 120 Amp-hours (Ah) operating at 12 Volts, multiplying the battery voltage by the Amp-hour rating provides the Watt-hours of the battery as shown in the following equation:

12V x 120Ah = 1440 Wh

Watt-hours are used to measure battery capacity and battery life, estimate the number of times the battery can recharge or power a device, and provide a metric for comparing battery performance. Watt-hours are also used as a measure of how much energy a solar panel can produce.

Each piece of SCS equipment has different a power consumption depending on the electrical needs and the overall usage duration. The table below shows the electrical specification and the power consumption of some of the SCS devices that can be found in the field that {TESS+} has tested and standardised for use by the UNSMS.

VHF/UHF standard repeaters and base stations:

Equipment model	SLR5500	IC-FR5100	DM4601	DM2600	IC-F5062D	IC-F5400D
Description	Repeater	Repeater	Base station	Base station	Base station	Base station
RF Output Power	50W	25W	25W/45W	25W/45W	25W	25W/50W
Input Voltage AC	100-240 VAC	-	-	-	-	-
Input Voltage DC	11-14 VDC	13.2 VDC	13.2 VDC (nominal)	13.2 VDC (nominal)	13.2 VDC	13.2 VDC
Current drain (standby) AC 110/240	0.25A / 0.18A	-	-		-	-
Current drain (Transmission)AC	1.5A / 0.9A	-	-	-	-	-
Current drain (Standby) DC	0.7A	0.5A / 2.4A (receiving)	0.81A / 2A (receiving)	0.81A / 2A (receiving)	0.3A / 1.2A (receiving)	0.37A / 0.9A (receiving)
Current drain DC (Transmission)	9.5A	8A	11A (at 25W) 14.5A (at 45W)	11A (at 25W) 14.5A (at 45W)	7A	5.0A (at 25W) 9.0A (at 50W)
Power consumption VAC 110/240 (standby)	27.5W / 43.6W	-	-		-	-
Power consumption VAC 110/240 (transmission)	165W / 216W	-	-		-	-
Power consumption VDC (standby)	8.4W	6.6W / 31.68W (receiving)	10.7W/26.4W (receiving)	10.7W/26.4W (receiving)	3.96W / 15.84W (receiving)	4.88W/11.88W (receiving)
Power consumption VDC (transmission)	135.8W	105.6W	145.2W (at 25W) 191.4W (at 45W)	145.2W (at 25W) 191.4W (at 45W)	92.4W	66W 118.8W

VHF/UHF handheld radio:

Power for charging handheld battery: **15W**

RSOC related devices:

Cubic Vocality:

Device power requirements: **5-35VDC (or 220VAC adapter)**
Current drain: **0.62A, 5A(max)**
Power consumption: **7.5W**

ICOM IP2AIR:

Device power requirements: **10-20VDC (or 220VAC adapter)**

Current drain: **0.5A**, **2A(max)**
Power consumption: **6W**

<u>Basic (non-POE) 8-port switch:</u>
Power consumption: **5.4W***
<u>Basic router:</u>
Power consumption: **5.4W***

**As power consumption might differ according to the model, please refer to the specification sheet of each device for exact power consumption figures.*

<u>SAT phone with docking station:</u>

Device:	**Iridium Extreme**
Standby current/power:	**75mA / 1.1W**
Transmit + charging current/power:	**0.4A / 12W**
Sleep mode current/power:	**25mA / 0.3W**
Rated input:	**9-32VDC**

To estimate the charging time of the batteries, the power produced by the solar panel(s) and the electrical characteristics of the battery must be known. Using this data in the power equation will help to find the current used for charging which leads to calculating the charging time.

Example: If you have a solar panel producing at a full capacity 150Watt and a 12VDC battery with a 100Ah capacity, the charging current will be:

Current = Watt ÷ voltage

Current = 150W ÷ 12V = 12.5A

Divide the battery capacity by the solar panel current to get the estimated charge time. This assumes that the solar panel produces a consistent 12.5A.

Charging time = battery capacity ÷ current

Charging time = 100Ah ÷ 12.5A = 8 hours

Meaning that you need 8 Hours of daylight to be able to charge a 100Ah battery using a 150 W solar panels, the more panels use, the charging time will get reduced.

There are tools which are available to provide accurate real-time readings such as an energy monitor, also known as an electricity usage monitor. An energy monitor measures and tracks the energy consumption of electrical appliances and devices in a household or office setting. It helps users understand how much electricity specific devices are using.

Figure 11: Electricity usage monitor

Annex B – Backup power solutions calculation matrix – Spreadsheet attached.

Recommended backup power setup for SCS equipment				
		6 hours back up power	**12 hours backup power**	**24 hours backup power**
Repeaters	*SLR5500*	1 x 12VDC 150Ah + 200 Watt Solar Panel for charging	2 x 12VDC 150Ah + 300 watt Solar Panel for charging	3 x 12VDC 150Ah + 300 watt Solar Panel for charging
	IC-FR5100/6100			
Base stations	*DM4601(45 watt)*			
	DM4601(25 watt)			
	DM2600(45 watt)			
	DM2600(25 watt)			
	IC-F5062D			
	IC-F5400(25 watt)			
	IC-F5400(45 watt)			
ROIPS	*Vocality Cubic*	1 x 12VDC 50Ah + 150 Watt Solar Panel for charging		
	IP2AIR			
Ethernet devices Combined	*8 PORT SWITCH*	1 x 12VDC 50Ah + 150 Watt Solar Panel for charging + DC to AC Inverter		
	Router			
SAT PHONE	*Iridium with docking station*			
HF(Phase out)	*Codan Envoy*	1 x 12VDC 150Ah + 200 Watt Solar Panel for charging	2 x 12VDC 150Ah + 300 watt Solar Panel for charging	3 x 12VDC 150Ah + 300 watt Solar Panel for charging