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Evaluation and Resolution of Identified Issues at CTBTO Auxiliary Seismic Stations in Indonesia Based on Incidents Reported over the last five Years

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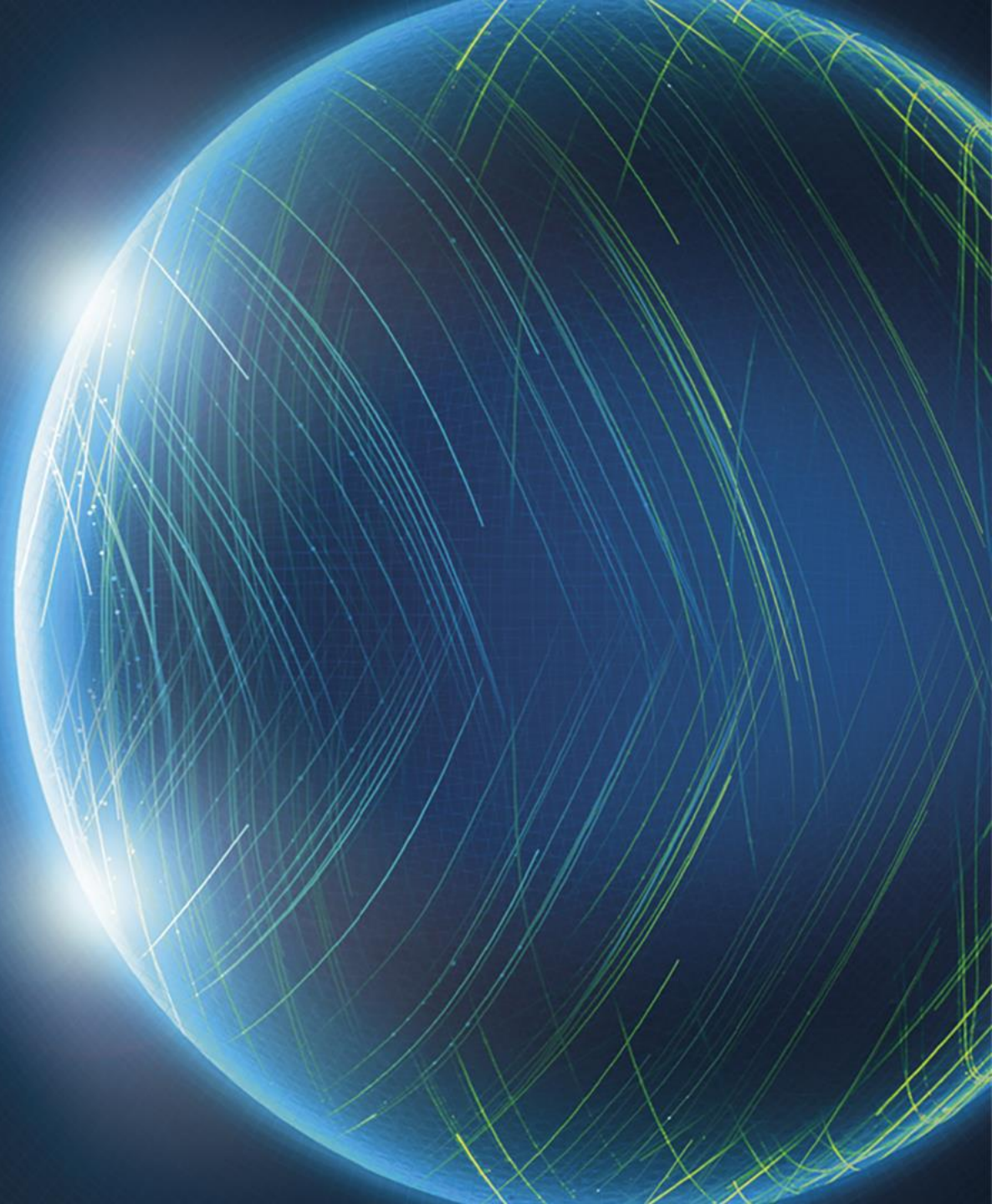


Introduction

There were 44 incidents were reported in the IMS reporting system (IRS) PTS, related to power problems at six Auxiliary IMS stations in Indonesia (BATI, SIJI, JAY, KAPI, LEM, and PSI) from 2018 to 2022.

Instability in the power system in **six Auxiliary IMS stations in Indonesia** indeed have **an impact on the performance of the station**. Seismic stations are equipped with sensitive instruments that measure ground vibrations and seismic waves. These instruments require a stable and reliable power supply to function properly. As well this issue has affected **to GCI link performance NDC-ID**.

To ensure the reliability of seismic station performance, it is important to have a stable and uninterrupted power supply. Proper power system design, including backup power solutions, surge protection, grounding, and regular maintenance, helps mitigate the risks associated with power-related issues and ensures the continuous operation of seismic stations.

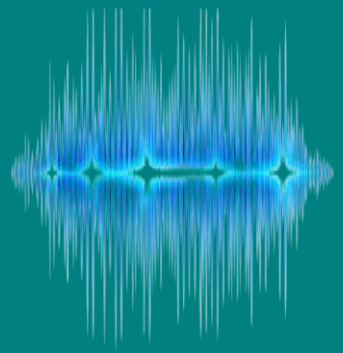
What were the most impacted?

According to reported cases of power system instability affecting the performance of an Indonesian seismic station, as follows:

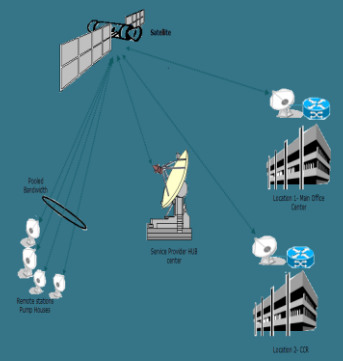
Power Outages: If power outages occur frequently in the area where the seismic station is located, the station may **lose power**, **disrupting data collection and transmission**. Power outages can cause **gaps** in seismic data, ensuring accurate analysis and interpretation of seismic events difficult.

Data Loss: Power system instability can lead to **voltage fluctuations**, **surges, or power spikes**. These electrical disturbances can **damage** the **electronic components of the seismic station**, including data loggers, sensors, and communication systems. Data loss or corruption may occur, impacting the reliability and accuracy of the seismic data recorded by the station.

What were the most impacted?



Noise Interference: Unstable power systems can introduce electrical noise into the operation of a seismic station. This noise can interfere with the sensitive instruments, leading to distorted or contaminated seismic data. Electrical noise can make it **challenging to identify and analyse seismic signals accurately**, potentially affecting the station's ability to detect and report seismic events.



Communication Issues: Seismic stations often rely on real-time data transmission to central monitoring stations or data analysis centre. Power system instability can disrupt communication channels, causing **delays or interruptions** in data transmission. This delay in data reporting may hinder timely response efforts or scientific research related to seismic activity in the region

What are the challenges of dealing with power system improvements?

The following are the challenges of improving the power system:

- There are no **funds** or **budget allocations** for the station's sustainability.
- **Remote locations**: These locations often lack a reliable power infrastructure, making it challenging to establish a stable power supply. Extending the power grid to these remote sites can be logistically difficult and expensive.
- **Natural Disasters**: These events can cause damage to power infrastructure, including transmission lines, substations, and generators, affecting the reliability of the power supply. Implementing power system improvements that can withstand and recover quickly from such disasters is crucial.
- **Maintenance and Support**: Maintaining and servicing the power systems at seismic stations can be challenging, particularly in remote locations. It may require trained personnel and specialized equipment to diagnose and repair power-related issues. Ensuring a consistent supply of spare parts and having an efficient maintenance plan is essential for sustaining the reliability of the power systems.
- Management **priority** and **decision** for station’s sustainability.

Maintenance Duration

- Combination of those challenges and problems usually are the main caused that consume time to solve the problem
- Immediate response and action are on hold because of those challenges and obstacle

How can this be mitigated?

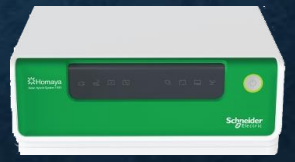
Several measures can be taken to mitigate the impact of power system instability on seismic station performance:

Backup Power: Seismic stations should have better backup power sources and technology lead acid battery should replaced by lithium because more durable. New hybrid SCC technology also could be use combine with local 220vac (if any). These backup systems can provide temporary power during outages, ensuring continuous operation of the station and preventing data loss.

Lead Acid Battery

Lithium iron phosphate Battery

Hybrid Solar Charge Controller



Without Battery

With Battery

Several measures can be taken to mitigate the impact of power system instability on seismic station performance:

Redundant Power Sources: Implement redundant power sources, such as backup generators or renewable energy systems, to enhance the reliability of the power supply. Backup generators can automatically activate during power outages, ensuring continuous operation of the seismic station. Renewable energy systems, such as solar panels or wind turbines, can provide sustainable power in areas with limited grid access.

Power System Design Considerations: When designing or upgrading power systems at seismic stations, consider factors that enhance stability. These include proper grounding techniques, electrical isolation for sensitive instruments, and voltage regulation mechanisms. Design power systems with flexibility and scalability in mind to allow for future expansion or integration of new technologies. **Consider re-evaluation and redesign of the power system at six auxiliary stations with support from PTS-CTBTO which will be one of the aspects that can improve station performance**

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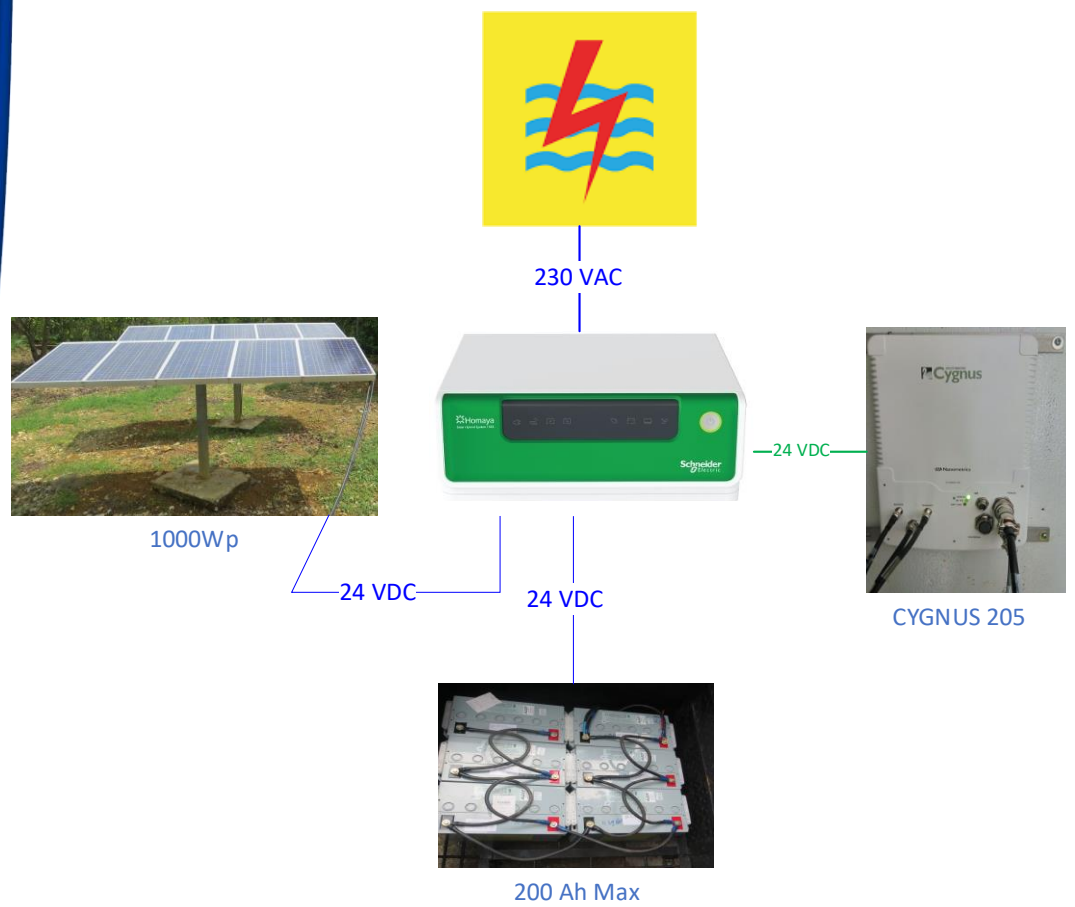
Implementation illustration



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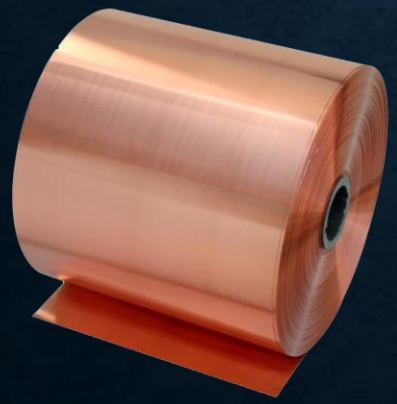
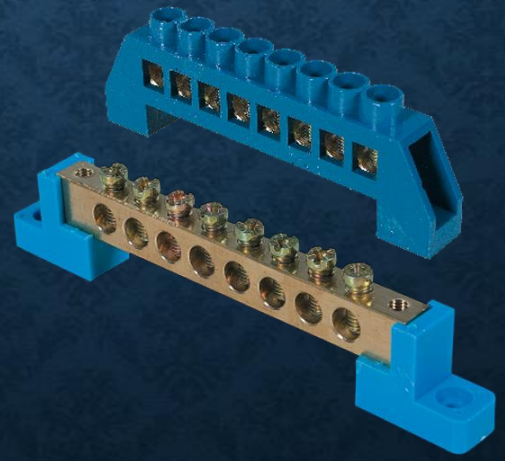
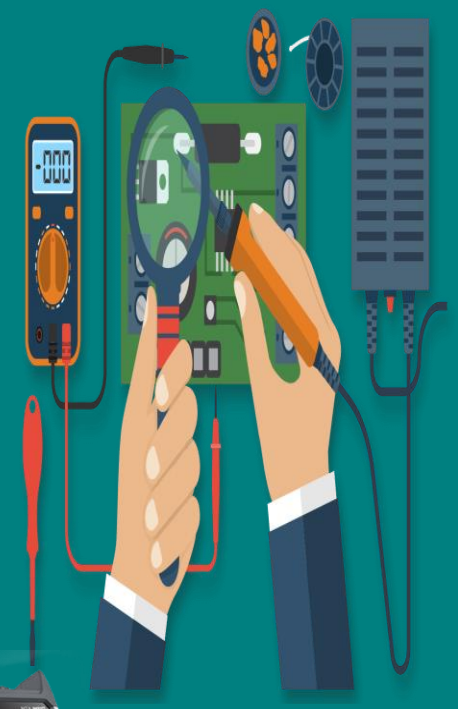
Power Conditioning: Installing power conditioning equipment, such as voltage regulators and surge protectors, can help stabilize the power supply to the seismic station. Smart UPS at NDC also provide stabilize power supply to server network. These devices can mitigate the effects of voltage fluctuations and protect sensitive equipment from electrical disturbances.

Grounding and Shielding: Proper grounding and shielding techniques can help minimize electrical noise interference in the seismic station. Grounding systems should be designed to redirect electrical currents and reduce the impact of electromagnetic interference on the instruments.



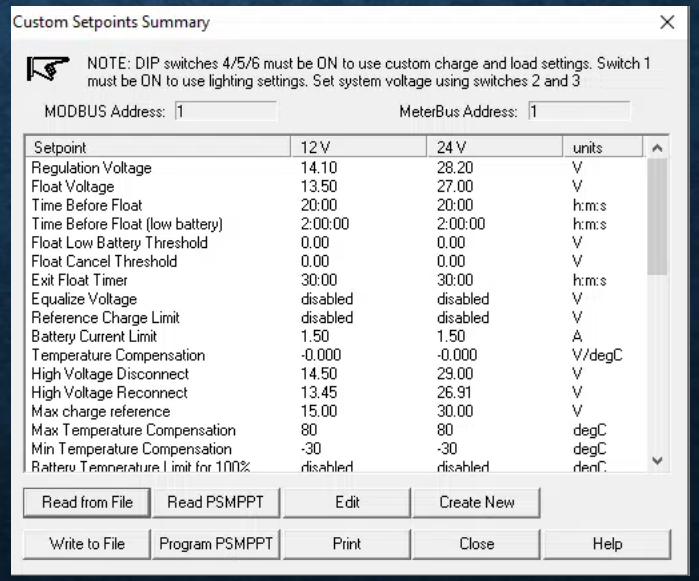


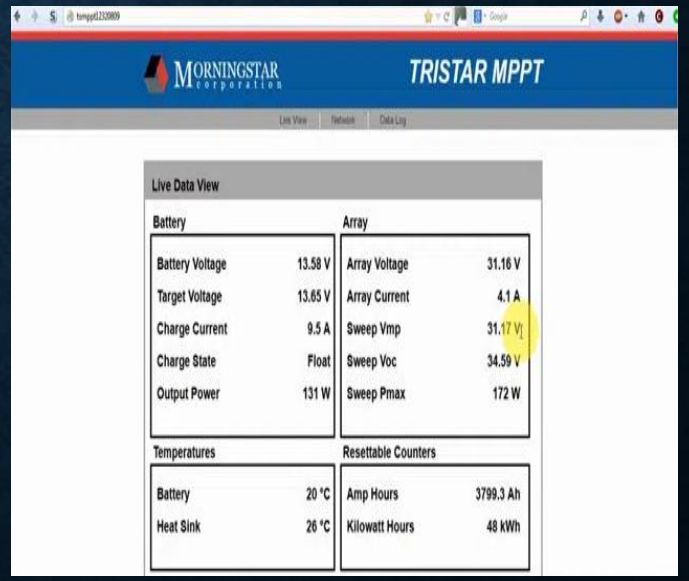


Field operator equipment and SOP : Proper equipment will help field operator to measure as acerate as possible. Accurate read will help to identify problem and implement proper troubleshooting. Maintenance period could be expedited to shorten outage. Provide training as well SOP to station operators and staff on power system management, troubleshooting procedures, and emergency response protocols.

Regular Maintenance and Testing: Implement a proactive maintenance and testing regime to ensure the reliability of power systems. Regular inspections, equipment calibration, and preventive maintenance can help identify potential issues and address them before they impact the seismic station's performance. Periodic testing of backup power systems ensures their readiness in case of emergencies.

Remote Monitoring and Diagnostics: Implementing remote monitoring capabilities can help detect power system issues and equipment failures at the seismic station. Real-time monitoring allows for proactive maintenance and troubleshooting, reducing downtime and optimizing station performance. At the moment power monitoring only (voltage)input of digitizer and modem. It will be more helpful if we know what truly happen with all power component in remote site to determine actual power problem. Additional equipment are needed (combine with SCC)





Conclusion

By implementing these measures, the impact of power system instability on the performance of seismic stations can be minimized, ensuring reliable and accurate seismic data collection and analysis.

Consideration of power system re-evaluation and redesign at six Indonesian auxiliary stations, with support and advice from PTS-CTBTO, is a potential way to improve the station's power system performance.

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