ARIZONA PUBLIC SERVICE GUIDES JORDAN UTILITY ON USING KPIS AND MANAGING DISRUPTIVE POWER SURGES

USAID/USEA EXECUTIVE EXCHANGE TO PHOENIX, ARIZONA

WASHINGTON, DC – To drive efficiency gains in technical operations and financial management, Jordan's National Electric Power Company (NEPCO) learned how to use key performance indicators (KPIs) during an executive exchange with Arizona Public Service (APS). NEPCO also consulted with APS on managing disruptive power surges on their transmission network, an important part of enhancing Jordan's grid reliability and efficiency. These meetings occurred from April 16-21 as a part of U.S.-Jordan Electric Power Transmission Partnership Program, an ongoing project supported by the U.S. Agency for International Development (USAID) Jordan Mission.

A delegation of eight NEPCO executives engaged in meetings, presentations, roundtable discussions and site visits in Phoenix and surrounding areas to share information on how to improve the technical and financial performance of an electric utility. This partnership targets improvements to NEPCO's commercial viability by providing technical support in transmission planning, operations and maintenance; and by sharing best practices on utility management, governance and support services.

EXECUTIVE EXCHANGE HIGHLIGHTS

During this program, NEPCO and APS officials met to discuss technical and non-technical issues of strategic importance to Jordan's transmission company: creating and instituting KPIs to track and benchmark NEPCO's technical performance against industry standards; power system modeling; attaining and maintaining quality assurance certifications; and auditing and financial management.

From left to right: Eng. Iman Altirawi (NEPCO), Taysir Abu Lawi (NEPCO), Tareq Al-Darawsheh (NEPCO), Kamil Al-Atout (NEPCO), Lauren Dickerson (USEA), Dr. Baj Agrawal (APS), Eng. Amer Al-Shdaifat (NEPCO), Samir Alhinnawi (NEPCO), Eng. Mamoun Shehadeh (NEPCO) and Eng. Feda Muwanes (NEPCO) gather outside Arizona Public Service in Phoenix, AZ.

BACKGROUND ON JORDAN'S POWER & ELECTRICITY TRANSMISSION SECTOR

NEPCO is a government-owned company operating under severe financial constraints due to unexpected fuel supply interruptions for Jordan's power plants. Accordingly, NEPCO's leadership is looking to employ all cost-effective means necessary to reduce their operating costs while maintaining system reliability and stability.

More specifically, NEPCO recognizes the need to benchmark its performance against comparable electric utilities in other countries in order to better understand how they can most effectively use its financial, human and capital resources to the greatest benefit of its network and customers.

Daniel Froetcher, Vice President of Energy Delivery at APS, discusses electricity pricing and cost recovery with NEPCO delegates.

USING KEY PERFORMANCE INDICATORS (KPIs)

Like their Jordanian counterparts, APS looks to other utilities to understand how they rank against other players in the U.S. utility industry. In order to do this, APS developed a strategic framework that identified the company's vision, mission, critical focus areas and business plans for each of the company's business units. They quickly realized, however, that their business plans needed to be better integrated with one another and measured by quantifyable, objective metrics, or KPIs.

The result of this ongoing 2.5 year process will be a list of KPIs that relate to each department's individual business plan that will be tracked by APS management and linked to employee performance evaluations based on each employee's specific responsibilities.

MANAGING DISRUPTIVE POWER SURGES WITH ACCURATE POWER SYSTEM MODELS

Since 2001, NEPCO has observed signs of system instability resulting from oscillations, or surges, in power flows from interconnected countries. NEPCO management recognizes the need to strengthen its network to prevent such power flows from disrupting reliability, but must do so by the most cost-effective means possible.

APS provided NEPCO with case studies of similar oscillation phenomena that occurred on their system and showed them how they addressed these problems with power system modeling and model validation. APS collected voltage and frequency data from generators connected to their system, as well as from equipment that provides voltage support along their transmission lines, to identify areas on the system that needed additional voltage support.

APS emphasized the importance of validating model simulations by testing the voltage and frequency of generators connected to NEPCO's system in order to ensure that their models are based on correct inputs. They recommended that NEPCO use specific software programs, such as PSS/E and GEPSLF, to model voltage oscillations. APS also recommended that NEPCO require power plants in Jordan to install power system stabilizers (PSS) on their generators. These PSS are relatively inexpensive and can dramatically improve long term network reliability as NEPCO continues to add new power generation to their system.

John Demcko, Senior Consulting Engineer at APS, demonstrates the impact of PSS (white box to the right of laptop) on a generator with unregulated generator during a tour of APS's technical projects lab.

NEPCO visited four solar power facilities during this exchange to APS, including three PV plants owned by APS (see above) and one concentrated solar power (CSP) plant owned by Abengoa, a Spanish solar power developer.

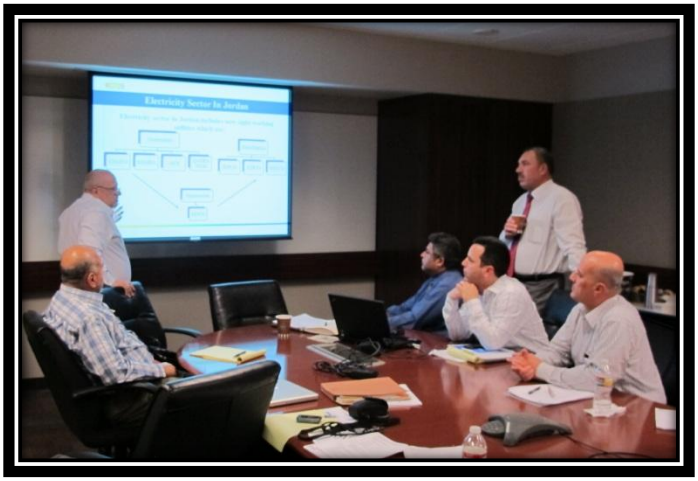
ISO 14001 CERTIFICATION AND IMPROVING ACCOUNTABILITY IN ENVIRONMENTAL AND SAFETY MANAGEMENT

To establish its reputation as a world-class utility, NEPCO has begun the process of applying for the internationally-recognized ISO 14001 (environmental management) and OHSAS 18001 (occupational health and safety) certifications. APS certifies its power plants for ISO 14001 and was able to offer its experience with the certification process and compliance. After implementing ISO 14001 quality assurance systems, APS found that they were reducing their medium term operating costs, identifying and correcting company weaknesses and standardizing environmental compliance processes. They also encouraged NEPCO to consider attaining multiple ISO certifications at once in order to reduce costs on external compliance audits and internal oversight on standards conformance.

RESULTS

The NEPCO Executive Exchange Visit to APS gave NEPCO delegates the opportunity to interact with APS experts to discuss matters pertaining to KPIs, power system modeling, environmental and safety certifications and auditing and finance.

- **Key Performance Indicators (KPIs):** Based on APS's experience, NEPCO plans to use root driver analysis tools in the development of their KPIs, as well as with their environmental management and occupational health and safety systems. APS and NEPCO discussed the process employed by APS to identify relevant KPIs that benchmark and track the company's performance against industry standards and company history. They discussed how these KPIs are incorporated into each department-level business plan, relate to measurable performance criteria and can be traced back to individual employees' responsibilities. NEPCO delegates learned about the business planning process at APS and received a template for the structure of APS's business plans. NEPCO delegates also learned to use different tools for identifying and analyzing the underlying causes behind the company's failure to fulfill any KPI criteria.



Samir Alhinnawi, Assistant Managing Director of Finance at NEPCO, explains NEPCO's current debt structure and debt burden to APS's Dan Sarti and David Benevidas.

Documents Transferred:

  - APS's how-to guide on conducting root driver analyses
  - APS's business plan design outline
  - Matrix of high-level KPIs for APS's corporate office and individual business units
  - Templates for documenting initiatives aimed at meeting performance improvement goals

- **Power System Planning and Protection:** NEPCO delegates learned about the process of power system modeling for transmission system planning and protection applications. NEPCO conveyed some of their system stability problems to APS, as well as their methods for maintaining system stability. Having had similar phenomena occur on their system in the past, APS provided NEPCO with the names of equipment manufacturers and models for power system stabilizing (PSS) equipment that they use on their generators.

NEPCO toured APS's technical projects lab, where they saw a demonstration of APS's PSS equipment. Delegates learned the importance of tuning PSS equipment to their own system's specifications rather than those of the equipment manufacturer. NEPCO committed to working with generators connected to their transmission system to tune stabilizer and exciter equipment for optimal performance with Jordan's transmission network.

Documents Transferred:

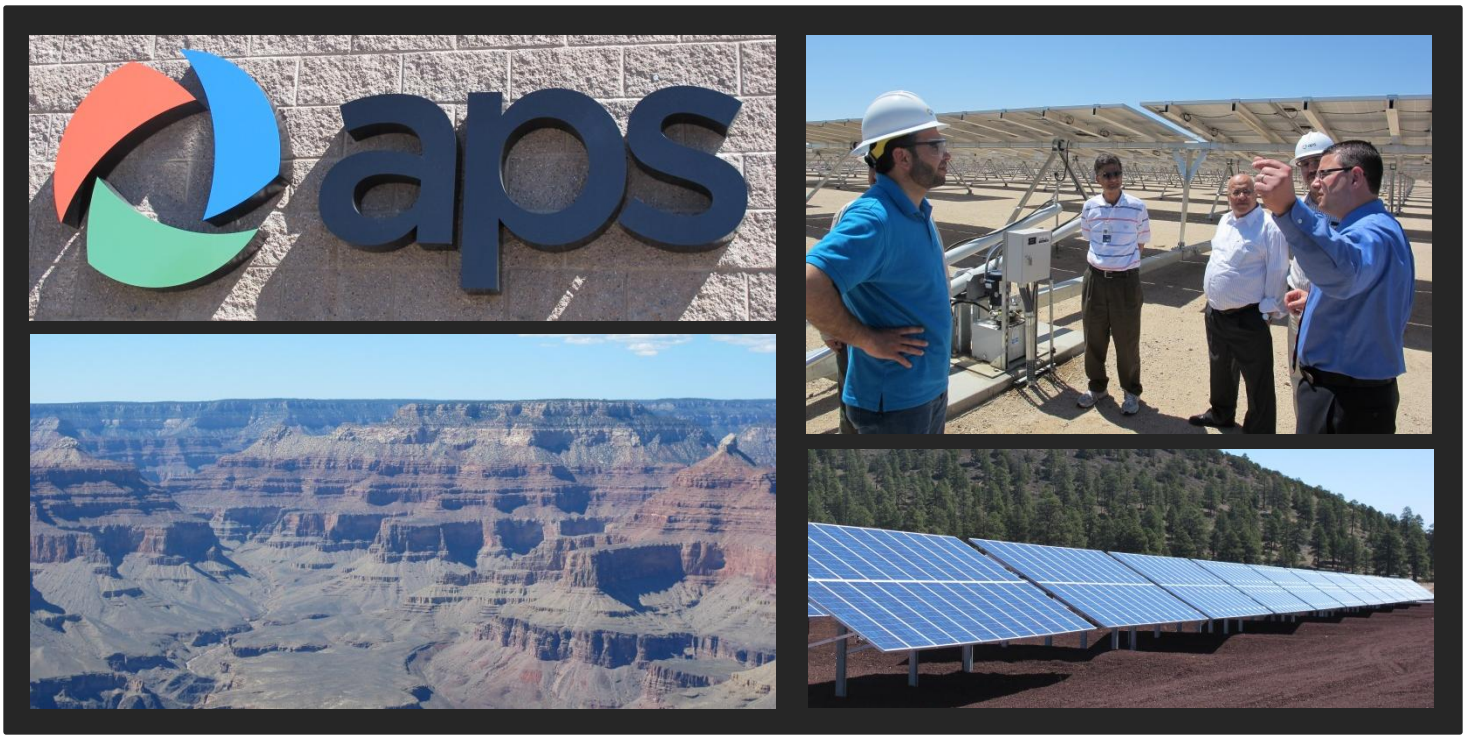
- Discussion of power system modeling and its role in the transmission planning process
- Transmission planning coordination in the WECC
- Case study of small signal stability at APS
- Guidelines for WECC/NERC mandated generator re-testing
- Case study of 4500 MW generation trip (unplanned disconnect) on APS's system
- Implementing PSS at power plants

- **Environmental and Safety Standards:** APS advised NEPCO on the process for obtaining ISO 14001 (environmental management) and OHSAS 18001 (occupational health and safety) certifications. NEPCO received many documents from APS, including risk mapping templates and guides, training materials for environmental standards compliance and a step-by-step guide to establishing and certifying an environmental management system. NEPCO remains committed to pursuing and obtaining these certifications.

  Documents Transferred:

  - Environmental management definitions card for APS staff working at ISO 14001-certified sites
  - Comparison of ISO 9001 and OHSAS 18001 common requirements
  - Comparison of ISO 9001 and ISO 14001 common requirements
  - Access to www.IntegratedStandards.com, a website that provides tools for integrating related ISO management systems

- **Auditing and Finance:** NEPCO delegates learned about the audit process and department structure at Pinnacle West (PNW), APS's parent company. They received a detailed overview of the steps involved in all audits at PNW, including planning, fieldwork, report writing, follow-up for corrective actions and closing an audit. NEPCO received a copy of PNW's audit report template, which conforms to International Professional Practices Framework, an auditing standards document published by the Institute of Internal Auditors. Regarding financial matters, NEPCO delegates learned about APS's debt and cash management practices for non-financial crisis periods. NEPCO delegates were also exposed to APS's financial planning model and resolved to investigate a



similar tool to assist them with such activities as budgeting, investment decisions, short and long-term cash flow analysis and credit monitoring.

Documents Transferred:

- Institute of Internal Auditors Practice Advisory 2050-2: Assurance Maps
- Guidelines for the role of internal auditors in integrated assusrance (integrated risk assessment)
- Templates for risk mapping, audit scheduling and audit planning
- PNW audit report template

PARTICIPATING ORGANIZATIONS

- **National Electric Power Company of Jordan (NEPCO)**
- **Arizona Public Service (APS)**

NEPCO PARTICIPANTS

- **Eng. Mamoun Shehadeh –** Operational Planning Section Head/Operational Studies Dept.
- **Mr. Taysir Abu Lawi –** Internal Audit Department Manager
- **Mr. Samir Alhinnawi –** Managing Director Assist / Financial Division
- **Mr. Tareq Al-Darawsheh –** Accounting Department Manager
- **Mr. Kamil Al-Atout –** Finance & Cash Management Dept. Manager
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