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GOVERNMENT OF INDIA  
**MINISTRY OF POWER**

# **EXECUTIVE EXCHANGE ON COAL FLEXING TO SUPPORT VARIABLE RENEWABLE ENERGY INTEGRATION AND GRID BALANCING**

**January 28 – February 1, 2019**

**Charlotte, North Carolina  
Denver, Colorado**

**United States of America**



## GTG BACKGROUND

India plans to deploy unprecedented levels of renewable energy (RE) on its power grid – 175 GW installed capacity of renewable energy (RE) by 2022. (Current estimates stand at approximately 43 GW of installed RE capacity.) Further, India's Nationally Determined Contributions (INDC) extends this ambition to 40% non-fossil fuels-based electricity generation capacity by 2030. This will greatly reduce the economy's carbon intensity and strengthen energy security. Compared to conventional power, however, India's key RE options are more variable, less predictable and often further from demand centers. Experience in other systems has shown that when penetration of RE reaches significant levels, the capacity of the power grid to manage it has to be addressed to avoid challenges to the reliability and affordability of electricity. Critical to integrating VRE into the power system is rigorous analytical support to identify grid stability issues, options for optimizing dispatch, and sources of potential flexibility.

USAID/India is assisting the government of India in integrating large scale, variable renewable energy (VRE) into the existing power grid through a four-year Greening the Grid (GTG) initiative that combines four activities, which interact with each other to help India meet its ambitious renewable energy targets.

1. An Interagency Agreement (IAA) with the U.S DOE Laboratories for power system planning reforms and targeted analysis for large RE parks and RE integration pilots (NREL);
2. Two India addendums (buy-ins) to the cooperative agreements with U.S. utility and regulatory associations
  - a. Regulatory Partnership for innovation between regulators (NARUC)
  - b. System Operators Partnership for innovation between grid operators (USEA)
3. A donor-to-donor agreement to support state-level cooperation to be defined in year one of GtG
4. Renewable Integration and Sustainable Energy (RISE) initiative to pilot grid integration reforms through public-private partnerships at the state and regional level and organize/provide TA (Deloitte)

A significant component of India's future success in expanding renewable energy supplies is the development of its capacity to plan and maintain grid stability and reliability while promoting flexibility throughout the power system. To support this goal, market systems must operate unimpeded, energy generation and load must be balanced in concert throughout the grid, and generation forecasting and scheduling must be supported by real or near real-time monitoring. This study tour, which is part of #2b listed above, is an important component of Greening the Grid's capacity building effort. This study tour strives to improve India's institutional capacity to better handle the variability, uncertainty, and other challenges specific to large volumes of RE resources on the grid.

## EXECUTIVE EXCHANGE GOAL & OBJECTIVES

### **Program Goal:**

As an implementing partner of the Greening the Grid/India program, the United States Energy Association (USEA) will be organizing a set of capacity building activities targeted at executives from India's Gujarat State Electricity Corporation Ltd. (GSECL) and NTPC India Ltd., as part of a Partnership Program on Coal Flexing to Support Variable Renewable Energy.

Studies conducted worldwide on addressing increased renewable energy penetration through flexible operations of coal-based power plants have underscored the need to identify, measure and quantify the effects of low load operations and cycling of units. The objective of the program is to discuss coal flexing operational practices, infrastructure improvements and damage mitigation techniques to confront impacts caused by flexing. In addition, activities will focus on applicable models to weigh the benefits arising out of the investments required to be made in the power plants for flexing operations. In countries such as India with high coal dependence but ambitious goals for integration of variable renewable energy, "hourly ramping" and "daily cycling" of coal power plants is becoming an increasing operational necessity. The partnership program aims at enabling power plant operators and engineers to gain from experiences from plants/utilities having successfully tried and adopted means of flexible power plant operations.

### **Executive Exchange Objectives:**

The objectives of this activity are to create a platform for peer-to-peer dialogue to allow U.S. utilities to share experiences and lessons-learned with their Indian counterparts on the use of coal-powered generation as a flexible resource to balance variable renewable energy generation.

Issues to be discussed include but are not limited to:

#### **1) Operational Practices to achieve flexible operations**

- Changes to the operating procedures in unit operation (from base load to low load operations)
- SOP for boiler, turbine and mill functions at low loads
- Cyclic operations including two shifting of units

#### **2) Addressing retrofit requirements for cycling**

- Turbine modifications to support increased flexibility
- Boiler retrofit requirements for sub-critical & super critical units
- Condenser retrofits to addressing larger storage volumes
- Costs associated with designing and introducing retrofits in units

#### **3) Improving Control Systems and Instrumentation**

- Addressing cycling requirements through enhanced instrumentation and control
- Preventive Maintenance and Condition Monitoring
- Pressure parts control and monitoring of firing systems
- Increased automation and remote operations of valves/systems
- Addressing burner management control and flame stability at low load operations

#### **4) Risks and Challenges with flexible operations**

- Modeling and associated costs amid increased frequency of equipment damage
- Effect of increased cycling/two shifting of units on emissions control (NOX, SO<sub>2</sub>, FGDs etc.)
- Economic benefits of cyclic operations
- Stressed asset disposal and overhauling

#### **5) Capacity building**

- Unit level training practices for enhanced plant operations
- Incentives/awards for flexible plant operations
- Operator's guide/handbook for low load operations
- Workshop interface/programs for plant and control room operations

Participants will work towards several deliverables during this executive exchange, including but not limited to:

- GSECL and NTPC will each complete an action plan of tasks their organization needs to complete to further the organization's capability of supporting coal generation as a flexible power source.

## PARTICIPANTS

### **INDIAN PARTICIPANTS**

|   |              |  |
|---|--------------|--|
| NTPC India Ltd.                                       | Executive #1 |  |
| NTPC India Ltd.                                       | Executive #2 |  |
| NTPC India Ltd.                                       | Executive #3 |  |
| Gujarat State Electricity Corporation Limited (GSECL) | Executive #1 |  |
| Gujarat State Electricity Corporation Limited (GSECL) | Executive #2 |  |

*GSECL and NPTC are welcome to include 1-2 additional participants at their own expense.*

### **U.S. GOVERNMENT & PRIVATE PARTNERS**

|   |                         |   |
|---|-------------------------|---|
| Ms. Monali Zeya Hazra, Senior Clean Energy Specialist     | USAID/India             | E: mhazra@usaid.gov   |
| TBD   | Deloitte/India          |   |
|   | Intertek                |   |
| Mrs. Johanna Koolemans-Beynen, Senior Program Coordinator | U.S. Energy Association | W: +1-202-312-1224<br>M: +1-301-979-5250<br>E: jkoolemans-beynen@usea.org |

## **GROUND TRANSPORTATION**

Delegates are responsible for getting themselves to the airport in their home country. **Ground transportation within the U.S. will be arranged by USEA staff prior to your arrival, including airport transfers for your arrival in and departure from the U.S.** USEA will arrange drivers and vehicles for meeting transportation throughout the study tour. **If you are having difficulty locating your driver, please contact the relevant company below. Reference the USEA program organized by Johanna Koolemans-Beynen.**

### **Charlotte, North Carolina**

TBD

### **Denver, Colorado**

TBD

In some rare instances, delegates may need to take a taxi during their stay in the U.S. in order to attend a meeting/event. In these rare instances, delegates may submit taxi receipts for reimbursement, so make sure to keep your receipts. It is necessary to instruct your driver that you will need a receipt before exiting the taxi. The receipt should detail: fare, tip, pickup location, and drop-off location. USEA cannot provide reimbursement without a receipt.

## **LODGING**

TBD

# **SCHEDULE**

## **Saturday, January 26, 2019 – Charlotte**

Arrival into U.S.

## **Sunday, January 27, 2019 – Charlotte**

Executive time. No scheduled activities.

## **Monday, January 28, 2019 – Charlotte**

### **Meeting with Electric Power Research Institute (EPRI)**

The Electric Power Research Institute (EPRI) conducts research, development, and demonstration projects for the benefit of the public in the United States and internationally. As an independent, nonprofit organization for public interest energy and environmental research, we focus on electricity generation, delivery, and use in collaboration with the electricity sector, its stakeholders and others to enhance the quality of life by making electric power safe, reliable, affordable, and environmentally responsible.

Background information on EPRI's research on the topic can be found [here](#).

## **Tuesday, January 29, 2019 – Charlotte**

### **Site visit to Duke Energy's Marshall Steam Station**

Marshall Steam Station is a four-unit coal-fired generating facility located in Catawba County, N.C. Named for former Duke Power President E.C. Marshall, the station is located on Lake Norman. One of the largest coal facilities owned by Duke Energy in the Carolinas, Marshall generates enough electricity to power approximately 2 million homes. Since it began commercial operation in 1965, Marshall Steam Station has been among the most efficient power plants in the nation.

Duke Energy has made significant improvements to reduce emissions from the company's coal-fired plants. A unique type of burner arrangement in the boilers keeps the nitrogen oxide emissions from the Marshall facility well below regulatory limits. In 2004, the company began installing flue gas desulfurization equipment – commonly known as scrubbers. This equipment will lower the station's sulfur dioxide emissions by approximately 95%. The project was completed in 2007.

## Wednesday, January 30, 2019 – transit

**Fly to Denver, Colorado**

## Thursday, January 31, 2019 – Denver

### **Site visit to Comanche Generating Station**

Comanche Station is the largest power plant in Colorado, with a total production capability of 1,410 MW (Unit 1: 325 MW, Unit 2: 335 MW, Unit 3: 750 MW). The plant, which became operational in the 1980s, has steam-driven generators, sourced with low-sulfur coal from the Powder River Basin near Gillette, Wyoming. It is located near Evraz Steel Mill, which is the single largest commercial account for Xcel Energy in Colorado. The addition of Unit 3 marked Colorado's first advanced, highly efficient, supercritical coal unit which can generate more electricity with less fuel. That saves customers money because it displaces higher cost electric generating units and provides greater operating flexibility. Xcel Energy has two partners in Unit 3: Intermountain Rural Electric Association (IREA) of Sedalia, Colo. (25 percent) and Holy Cross Energy (8 percent). Xcel Energy operates the entire plant.

Comanche Station controls air emissions with multiple technologies. Baghouses on all three units act like giant vacuum cleaners, removing more than 99 percent of particulate emissions from the flue gas. All units have low-nitrogen oxide (NOX) burners to control NOX, and lime-spray dryers to control sulfur dioxide (SO<sub>2</sub>) emissions. Activated carbon injection is used to control mercury emissions on all three units. Comanche Station is the first plant in Colorado to control mercury emissions.

Unit 3 has a selective catalytic reduction (SCR) system to also reduce NOX emissions. As a result of the plant's environmental improvements, overall emissions at Comanche Station are lower, even with an additional unit on line.

Comanche also has implemented a variety of water conservation projects to significantly reduce overall water consumption.

## Friday, February 1, 2019 – Denver

### **Site visit to Xcel Energy dispatch center**

Address: 1800 Larimer, Denver, Colorado

### **Site visit to Pawnee Generating Station**

Pawnee Station, located in Brush, Colorado, is a coal-fired, steam-electric generating station. Pawnee has a production capability of 505 megawatts. The plant, which became commercial operational in 1981, sources its low-sulfur coal from the Eagle Butte Mine near Gillette,

Wyoming. Pawnee has a comprehensive control system that enables reliable operations and state-of-the-art diagnostic troubleshooting. Also located on Pawnee Station property is the Manchief Power Plant, a 250 MW gas-fired combustion turbine plant. Manchief is owned by Capital Power Income LP. Xcel Energy purchases the electric output of Manchief.

Pawnee uses multiple technologies to reduce air emissions. A baghouse, installed in 1994, acts like a giant vacuum cleaner, removing particulate emissions from the flue gas by more than 99 percent. The plant also has fuel blending facilities, dust suppression and collection equipment, and low NOx burners to reduce emissions of nitrogen oxides.

New controls to further reduce emissions of nitrogen oxide and sulfur dioxide at Pawnee were installed in 2014. This was a result of the Colorado Clean Air-Clean Jobs Act, which Xcel Energy supported.

Pawnee Station is a zero-discharge plant, which means no process water is discharged from the plant site. Water for Pawnee is pumped five miles from wells to a 140-acre reservoir on the plant site. The Colorado Division of Wildlife raises fish in this reservoir.

Xcel Energy Point of contact:

Gerald Lyne

Pawnee Station Director

P: 970-542-4801 C: 970-380-8300 F: 970-542-4841

E: [gerald.lyne@xcelenergy.com](mailto:gerald.lyne@xcelenergy.com)

**Saturday, February 2, 2019 – Transit**

Depart the U.S. for India

# INFORMATION PACKET

## **DRESS CODE**

The dress code for the program will be a mixture of formal business attire (e.g. suit and tie) and casual attire, depending on the meeting. Delegates should wear close-toed shoes and dress casually for site visits. Any safety equipment necessary for site visits will be provided by the utilities/organizations. Comfortable shoes are recommended for travel days.

## **WEATHER**

Charlotte, North Carolina – Average high temperatures around 11° C/lows of 1° C  
Denver, Colorado – Average high temperatures around 7° C/lows of -8° C; snow likely

## **EMERGENCY**

In case of police, fire, and ambulance emergencies, dial **911** from any phone in the US. This is the emergency telephone number in all States. Once you are safe, please contact one of the USG or USEA representatives that will be accompanying you on this program activity.

## **PROGRAM RULES AND GUIDANCE**

### **Air Travel**

Your travel on this program is funded by the United States Government. Therefore, all travel must correspond with the official program agenda, and **extended layovers or side trips for personal reasons will not be arranged through USEA and should not be considered.**

Several important regulations associated with air travel on USEA programs should be noted:

- U.S. law requires all delegates on programs funded by the U.S. Government to fly into and out of the United States on American “flag carriers,” airlines such as American, Delta, and United or code share flights, such as a Lufthansa flight that also has a U.S. airline flight number. This is only highlighted so you are aware of why some airlines and routings are chosen over others.
- USEA can only purchase economy-fare tickets for the majority of program participants. Program participants are welcome to upgrade their tickets to a different class at their own or their employer’s expense.

### **U.S. Customs & Border Patrol (CBP) Tips**

Understand that CBP officers can inspect you and your belongings without a warrant. This may include your luggage and clothing.

- Do not bring any food into the United States.
- Do not bring any Cuban-made products into the U.S. no matter where you purchased them.
- Many foreign-made medications are not legal in the U.S. and may be confiscated. Bring only the amount of medication you will need for personal use during your stay.

The U.S. Transportation Security Administration (TSA) no longer accepts locked luggage, with the exception of TSA-approved locks, which can be purchased at most airports. If you lock your luggage with a non-TSA-approved lock, TSA may break the lock in order to inspect your luggage. TSA will leave an inspection note in the luggage if it has been inspected.

### **Passports, Agenda, & Visa Documentation**

You are strongly encouraged to carry these items with you at all times for the duration of your stay in the United States:

1. **Passport**
2. **Program Agenda**
3. **Visa Documentation**

Please note that upon arrival in the United States, immigration agents may ask to see the **program agenda** to verify your reason for visiting. Be sure to keep the agenda with you on the plane so that it is available for immigration agents to inspect.

### **Lodging Rules**

USEA pays for **hotel room & tax charges only**. **Delegates are responsible for all other charges**. These incidental charges include meals which are not specifically paid for by USEA, telephone calls (both domestic and international), in-room movies, room service, laundry, baggage handling, telephone calls, and any bills charged to the room from restaurants, bars, and lounges. All incidental expenses charged to the hotel room are the responsibility of the visitor, and must be paid for at the time of checkout. **USEA cannot pay for them**.

In most hotels, guests who do not have a credit card may be asked to pay a security deposit in cash for possible incidental charges. This ensures the hotel that payment of any incidental charges will be guaranteed. Upon check-out you will receive your deposit, less the money spent by you for your incidental charges. If your incidental charges exceed your deposit, you are required to pay the hotel the difference at the time of check out. Please ask a USEA staff member about any questions regarding incidental charges upon your arrival.

### **Meals**

Participants are responsible for paying for their meals during a program using per diem funds provided by USEA or their own employers. For this program, however, some meals will be paid for by USEA. Arrangements for such meals will be explained by your USEA program officer during orientation.

Please keep in mind that **USEA is prohibited from paying for alcohol at any time**. Therefore, delegates who consume alcoholic beverages will be responsible to pay for them, **even for a meal hosted by USEA**. If you have any questions about meal arrangements, ask your USEA staff during orientation.

### **Per Diem Cash Allowance**

According to U.S. Government regulations, you are entitled to a monetary allowance for each day that you are in the U.S. to be used for meals and incidental costs not sponsored by USEA or training providers. This applies to U.S. Government-funded programs only.

This monetary allowance is known as "per diem" and is normally paid to you in U.S. dollars shortly after your arrival. The amount of money you receive is determined by the U.S. Government and varies according to location in the U.S. The per diem allowance is intended to cover the following expenses: meals not sponsored by USEA or training providers, telephone calls, laundry, baggage handling, and tips/gratuities.

Please note that once your per diem allowance has been spent, no further funds will be provided by USEA.

## **Program Attendance**

The purpose of your visit to the U.S. is to safely and productively learn and experience as much as possible in a short period of time. **You must participate in all events scheduled in the agenda** for this to be possible. If there is a particular reason that you will not be able to attend an event, you must notify an USEA representative prior to or at the time of your arrival in the U.S. USEA strives to make adequate provisions for free time in the evenings and on days when no formal activities are scheduled.

## **Smoking**

Smoking is illegal or in the process of being outlawed in most public places in the United States, such as in airports, restaurants, and office buildings. Many hotels now completely prohibit smoking in all guest rooms. Fines may be issued by the police for not adhering to smoking laws. The best advice is to ask someone for a location where it is permissible to smoke prior to lighting up. When in doubt, assume that you cannot smoke indoors!

## **Health Coverage**

USEA provides limited health insurance coverage for the duration of your travel in the United States. When a medical issue arises during the course of a program, you should inform an USEA or USAID staff member as soon as possible. In case of a medical emergency, immediately call local emergency responders by dialing 911 on the nearest available telephone.

Your health and accident coverage (HAC) provider for this exchange is HTH Worldwide. Each of you have been provided with an information regarding your insurance, which includes contact information for making a claim for medical costs that you may incur on your trip. In the United States, emergency room services and ambulance costs are to be paid either by the individual receiving treatment or by the insurance provider who covers the individual receiving services. **You should always carry a paper printout version of your HAC insurance card with you in case of an emergency.** That way, you can provide your insurance information to a hospital if you need to receive treatment in an emergency.

## **HTH Worldwide Contact information:**

Member Customer Service

Email: [studentinfo@hthworldwide.com](mailto:studentinfo@hthworldwide.com)

Toll-free number: 1-888-350-2002

Collect call number: 1-215-793-6925

HTH Worldwide also has a website, [hthstudents.com](http://hthstudents.com), which you can use to find more information about making a claim, download claims forms, and review your policy benefits and more. Please contact USEA if you have any issues making a claim, or if you have more general questions about your HAC insurance.

## **SAFETY AND MONEY TIPS**

It is vital that you are always aware of your surroundings when traveling. While we can work to ensure that your entire stay is safe and problem-free, we ask for your assistance in avoiding unnecessary risks. Avoid taking long walks at night, consuming excessive amounts of alcohol, or visiting the homes or hotel rooms of strangers.

**Some safety tips you may find useful are:**

- Upon your arrival at the hotel, ask USEA staff or hotel concierge for a map of the city in which you are located. Familiarize yourself with your location. Always carry a copy of your hotel's address and telephone number for your reference.
- We encourage participants to travel in groups outside the hotel, especially in the evenings.
- Do not stop to talk to homeless people or persons asking you for money. Never assume that strangers have good intentions.
- Always walk in well-lit areas, main streets and sidewalks with other pedestrians and open businesses.
- Always lock your hotel room door at night and do not open your door unless you are expecting someone and/or know the visitor. Call the front desk if you do not know someone who is at your door.
- Please leave valuables in a safety deposit box at the hotel front desk or in your hotel room safe.
- We discourage program delegates from bringing valuables on this exchange visit to the U.S. and cannot take responsibility for them in the event that they are lost or broken.

### **Tipping / Gratuities**

Tipping is more prevalent and expected in the United States than it is in almost any other country. As a courtesy, it is customary to "tip" for certain services. The practice of tipping is strongly encouraged because most service employees are paid minimal salaries and depend on tips to make a living. Remember that you are responsible for the payment of tips on your service purchases, not USEA. Suggested tip amounts follow:

- **Baggage Handling:** \$1 per bag if the bag is carried or delivered for you in a hotel or an airport.
- **Taxi Drivers:** 10% of the meter fare.
- **Restaurants:** 15% of the total bill is considered standard. 20% is generally tipped if service was outstanding.
- **Bartenders:** \$1 per drink.

It is important to remember that occasionally a service charge is automatically added to a restaurant bill. This is common practice in a restaurant where you may be eating with six or more people in your group. If you are unsure of the policy in a restaurant, it is appropriate to ask your server when you receive your bill. If a service charge is added, you should not leave a tip.

**Do not tip:** bus drivers, gas attendants, hotel desk clerks, or immigration/customs agents. It may be perceived that you are attempting to bribe immigration and customs agents if you offer money.