PNM 2017-2036
Integrated Resource Plan

JULY 27, 2016
DISCLOSURE REGARDING FORWARD LOOKING STATEMENTS

The information provided in this presentation contains scenario planning assumptions to assist in the Integrated Resource Plan public process and should not be considered statements of the company’s actual plans. Any assumptions and projections contained in the presentation are subject to a variety of risks, uncertainties and other factors, most of which are beyond the company’s control, and many of which could have a significant impact on the company’s ultimate conclusions and plans. For further discussion of these and other important factors, please refer to reports filed with the Securities and Exchange Commission. The reports are available online at www.pnmresources.com.

The information in this presentation is based on the best available information at the time of preparation. The company undertakes no obligation to update any forward-looking statement or statements to reflect events or circumstances that occur after the date on which such statement is made or to reflect the occurrence of unanticipated events, except to the extent the events or circumstances constitute material changes in the Integrated Resource Plan that are required to be reported to the New Mexico Public Regulation Commission (NMPRC) pursuant to Rule 17.7.4 New Mexico Administrative Code (NMAC).
AGENDA

RELIABILITY

Agenda

Morning

• Meeting Logistics
• Reliability of the Bulk Power System
• Reliability Services
• PNM’s Specific Reliability Responsibilities
• How Reliability Fits Into IRP

Afternoon

• Emerging Technologies
SAFETY AND LOGISTICS

• Fire escape routes via stairways at east and west ends of hallway; please let us know if you require special handicap egress or special assistance

• We must obey any fire or emergency alarm; even drills/test alarms

• Restrooms – Women's room at west end; Men's room at east end

• PNM’s WiFi

• Please be aware that there are outlets/network connections on the floor
SAFETY AND LOGISTICS CONTINUED

• Must sign-in with security desk each time you enter the building
• Must be escorted in and out of the building by a PNM employee
• Recycling is easy and encouraged
• Please note that meeting room is scheduled immediately following the IRP meeting
MEETING GROUND RULES

• IRP Public Advisory purpose is to solicit and receive public input
• Questions and comments are welcome
• Comments should be respectful of all participants
• Use name tents to indicate you have a comment or question
• Please silence your cell phone
• Reminder; today’s presentation is not PNM’s plan or a financial forecast, it is a discussion of PNM’s planning process
IMPORTANCE OF RELIABILITY

Reliability is the result of delivering electricity to customers within acceptable measures of quantity and quality.

Why is reliability important?

- Electricity is essential to our daily lives (public health, safety, commerce, etc.)
- PNM is required to comply with all NERC and WECC standards
RELIABILITY SERVICES

THE BUILDING BLOCKS OF THE ELECTRIC GRID

• Reliability Services are what a utility like PNM utilizes to operate the grid and fulfill requirements.
• Reliability Services are building blocks normally provided by generation.

  • Voltage Support Services: Operating the system to maintain system voltages
    – Regulation
    – Disturbance control
    – Reactive power supply
  • Frequency Support Services: Operating the system to maintain balance
    – Load following
    – Frequency response
BALANCING LOAD AND GENERATION

TOPICS DISCUSSED IN 2008 IRP

Load variability and uncertainty

Supply variability and uncertainty

DEMAND + RM

SUPPLY
BALANCING LOAD AND GENERATION

TODAY’S TOPICS

- Operating reserves for contingency events
- Regulation for frequency control
- Ramping capability
- Supply variability and uncertainty
- Load variability and uncertainty

Demand + RM

Supply
BALANCING LOAD AND GENERATION

WHAT HAS CHANGED?

Standards are evolving

NERC BAL-002
NERC BAL-002-WECC -2
NERC BAL-001
NERC BAL-003


Variable Energy (MW)
30 4 36 31 149 122%

Energy Efficiency (GWh)
58 79 76 75 79 274%

Annual Additions

In 2011, PNM’s system already had NMWEC, 6 MW of PV DG and savings from EE program implementation

Relationship between supply and demand is changing
### System operability is important and not reflected on the L&R table

- Must look at more than a single hour
- Variability is more of a probability question than an assignment of capacity
- Look at more than reserve margin that only covers the variability in loads and resources

How does the resource mix adequately provide the essential reliability services?
David Eubank
Director, Power Operations
PNM’S RELIABILITY RESPONSIBILITIES

KEEPING THE LIGHTS ON

• PNM maintains 24x7 operations to assure reliability for its customers and prevent adverse effects on neighboring systems.
• PNM has the responsibility and authority to take whatever actions are needed to prevent or alleviate problems on our system.
• Actions within PNM’s authority includes re-dispatch of generators, switching of facilities, adjust interchange, curtailment of energy schedules and, if conditions require, shedding load as a last resort.
• Virtually every aspect of PNM’s real-time operations are regulated
  - Balancing performance, mitigation of generation and transmission disturbances, system operator training, procedure development and adherence to those procedures, emergency plans, etc.

PNM operates under the observation of regional reliability coordination centers
  - one is in Loveland CO, the other is in Vancouver, WA
PNM’S SPECIFIC RELIABILITY RESPONSIBILITIES

POWER OPERATIONS

Insure transmission grid reliability in real-time via:

• Balancing Operations:
  – Assure that the supply of power and the demand for power within the PNM system remains in balance to maintain 60hz power – PNM has this responsibility within its operating footprint and shares grid balancing responsibility with about 37 other operating entities in the western interconnection

• Transmission Operations:
  – Monitor power flow on transmission elements (lines and transformers) and if necessary, make adjustments primarily through generation dispatch
  – Control the voltage profile on the transmission system
  – Facility restoration in response to forced outages – weather, animal contact
  – Manage planned outages for maintenance and construction activity
There are three interconnections in the continental United States:

- Western Interconnection
- Eastern Interconnection
- Texas, or TRE Interconnection

PNM operates at the southeast corner of the Western Interconnection.
Balancing Load and Generation

Balancing Operations – Balancing Area in the West

Performance is measured by “area control error”

All schedules for power and all flows of power into and out of the PNM system are continuously monitored, recorded and verified on an hourly basis with neighboring utilities.

Balancing performance is governed by NERC reliability standards.
TRANSMISSION OPERATIONS

POWER FLOW AND VOLTAGE CONTROL ON THE TRANSMISSION SYSTEM

- PNM operates 115kV, 230kV and 345kV transmission facilities
- All facility power flows are monitored
- Bulk power imports into northern NM are also monitored and managed to remain within reliable limits
- Operators receive notification via alarms of high loading levels
TRANSMISSION OPERATIONS

SYSTEM VOLTAGE REGULATION

- PNM manages the system to ensure that operating voltages are properly maintained throughout its service territory

- Why do we need to maintain voltage?
  - Keeping voltages at correct operating levels allows for electricity to be delivered in a reliable manner – protect PNM and customer equipment
  - Public Regulation Commission Rules

- How do we maintain voltage on our system?
  - Generator output voltage schedules
  - Operating transformer load-tap changers (LTC), voltage regulators, capacitor/reactor banks and static VAR compensators (SVC)
SYSTEM OPERATIONS

SYSTEM VOLTAGE REGULATION – DISTRIBUTION

Feeder Voltage Example

Reactive Support Example
OTHER RELIABILITY SUPPORT

COMPUTING SYSTEMS, OPERATING PROCEDURES, AND COMMUNICATIONS NETWORK

• PNM has IT staff support for its Energy Management System server systems and engineering staff support for its EMS/GMS\(^1\) applications

• Extensive procedures to address:
  – Black Start and System restoration
  – Load Curtailments
  – Backup control center operation

• Extensive communications system
  – Fiber optic loops within the Albuquerque metro area
  – Microwave system to reach over long distances

\(^1\) EMS/GMS – Energy Management System/Generation Management System
David Miller
Director, Wholesale Power Marketing
Essential Reliability Services
-6/10/2016-

- BAL-001-1 - Real Power Balancing Control Performance
- BAL-002-WECC-2: Contingency Reserves
- BAL-002-1: Disturbance Control Performance Standard (DCS)
Pat O’Connell
Director, Planning & Resources
HOW RELIABILITY FITS INTO IRP

RESOURCE MIX IMPACTS

• Planning and operations modeling must consider the increasing challenges of providing reliability on the system with an evolving grid.
  - Generating unit retirements;
  - The addition of wind, solar, geothermal, gas-fired plants; and
  - Increasing energy efficiency

• PNM considers the impacts of all these changes and plans a portfolio that maintains reliability over the foreseeable futures.
HOW RELIABILITY FITS INTO IRP

RELIABILITY SERVICES AND PORTFOLIO PLANNING

• PNM will consider how changes to the resource mix will affect reliability during the planning process.

• PNM will evaluate scenarios/portfolios against the cost and implications on reliability. Portfolios considered must provide adequate reliability.
ADDITIONAL RESOURCES

WHERE TO GO TO FIND MORE INFORMATION


MAKE SURE WE HAVE UP TO DATE CONTACT INFORMATION FOR YOU

www.pnm.com/irp for documents
irp@pnm.com for e-mails

Register your email on sign-in sheets for alerts of upcoming meetings and notices that we have posted new information to the website.

Meetings Schedule:
Thursday, August 11, 2016, 10 am – 3 pm
Thursday, Sept. 1, 2016, 10 am – 3 pm
Thank you