Session II: Reliability and Security of Electricity Supply Issues

5th NARUC/CEER Energy Regulators' Roundtable

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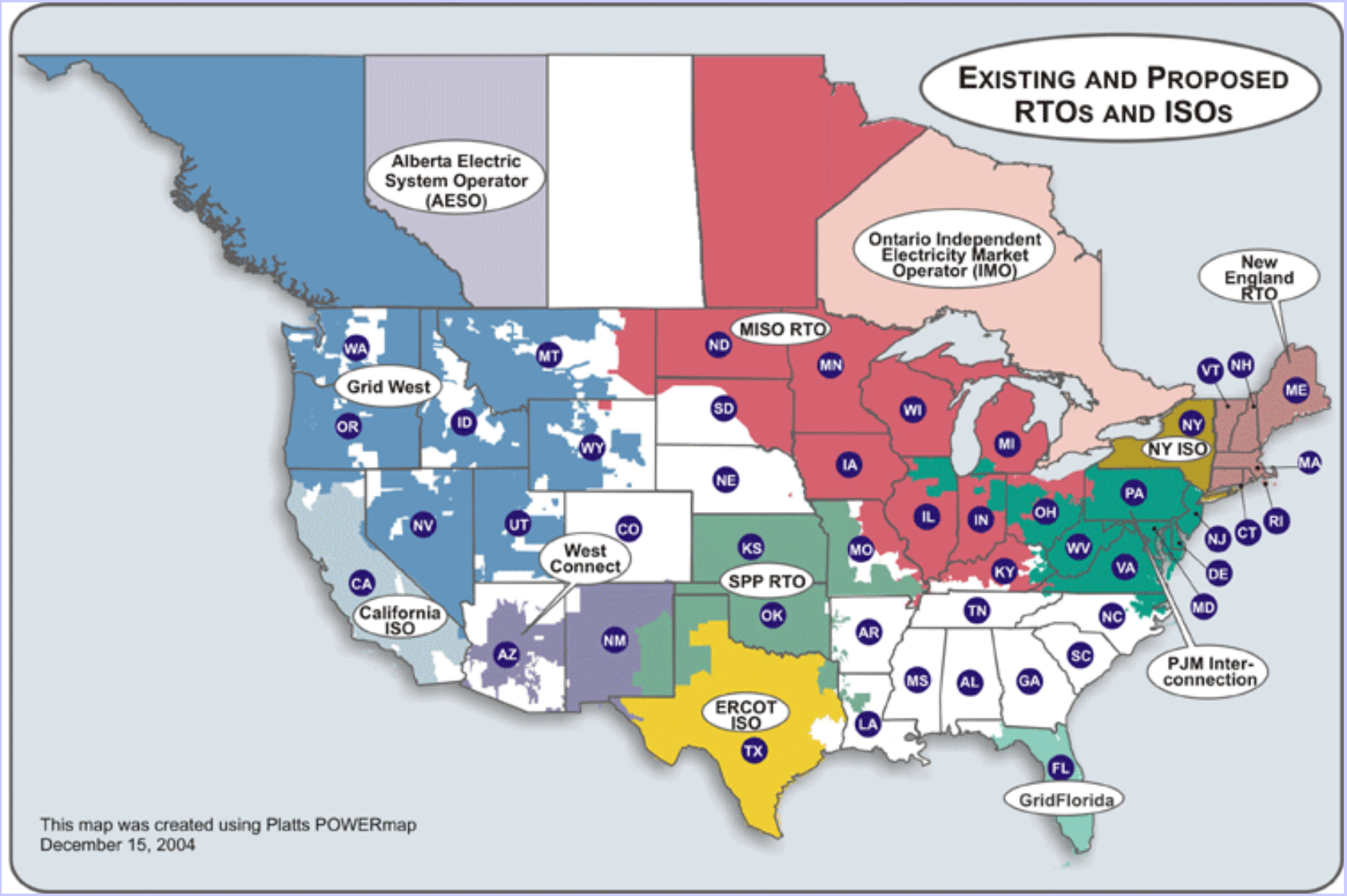
Overview

There are approximately 150 Control Areas/Transmission Service Providers (TSPs) in the U.S. electric power industry making this a complex issue –

FERC wants to reduce this to 12 regions and have a standard market design.

Regional Electric Market Issues – Missouri



Energy Providers:[1]

- Investor-owned Utilities (IOUs)
- Publicly-owned Municipal Utilities
- Cooperative Electric Utilities
- Federal and State Chartered Agencies and Utilities
- Independent Power Producers (IPPs)
- Power Marketers
- Non-utility Generators (NUGs)
- Exempt Wholesale Generators (EWGs)

1. From PGS Energy Training materials, Intro to the US Electric Power Industry

Energy Agencies and Organizations:[2]

- Regional Transmission Organizations (RTO)
- Independent System Operators (ISO)
- State Governments and Utility Regulatory Commissions
- Federal Energy Regulatory Commission (FERC)
- North American Energy Regulatory Commission (NERC)
- Environmental Protection Agency (EPA)
- Industry Associations

2. From PGS Energy Training materials, Intro to the US Electric Power Industry

Breakdown of US Power Supply[2]

66% of Power Provided by IOUs

16% of Power Provided by Publicly Owned Utilities

10% of Power Provided by Electric Cooperatives

6% of Power Provided by Power Marketers

1% of Power Provided by Federal Chartered Utilities

2. Derived from Energy Information Administration Class of Ownership Report, Table 17, based on 2003 Sales in megawatthours, found electronically at: http://www.eia.doe.gov/cneaf/electricity/esr/table17.xls

Reporting on the 2003 Blackouts: Common Issues and Possible Solutions

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What we already knew:

May 2002 USDOE National Transmission Grid Study[4] indicated:

- Grid was built over the past 100 years by vertically integrated utilities that produced and transmitted electricity locally.
- During the 1990's, competition was introduced into wholesale electricity markets to lower costs to consumers.
- Indications that grid is in need of modernization because demand growth is occurring faster than transmission supply.
- Transmission constraints are compounded by the incomplete transition to fair and efficient competitive wholesale energy markets.
- Eliminating transmission bottlenecks is essential to ensure reliable and affordable electricity now and in the future.
- Outlines 51 recommendations[5], with many directly related to reliability and security.

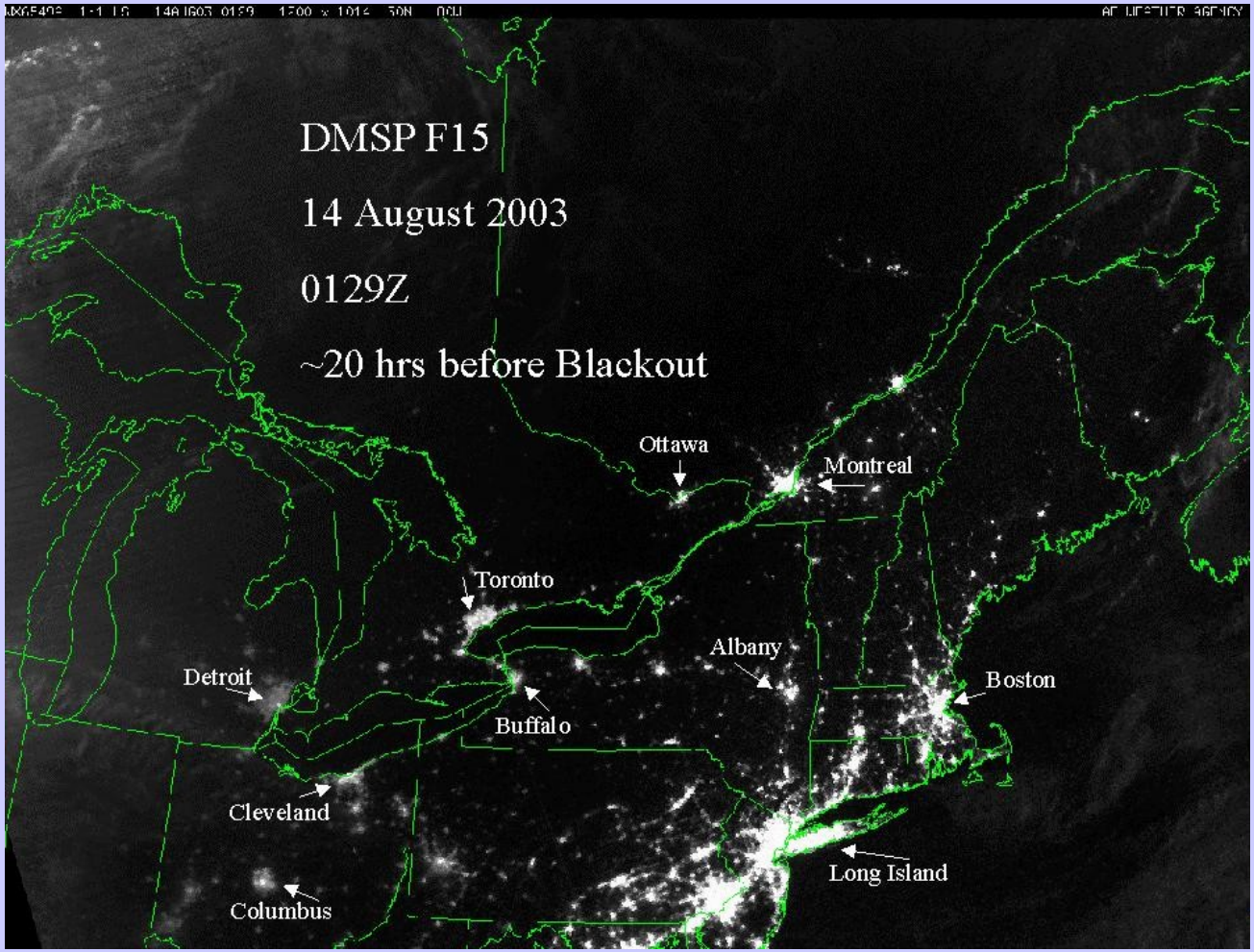
4. http://www.eh.doe.gov/ntgs/gridstudy/MAIN_EXSUM.PDF
5. http://www.eh.doe.gov/ntgs/gridstudy/MAIN_RECOMMENDATIONS.PDF

2003 Blackout
What Happened?

- On August 14, 2003, just after 4:00 pm (edt) the North American power grid experienced its largest blackout ever.
- An estimated 50 million people were effected
- More than 70,000 megawatts of electrical load was lost in parts of Ohio, Michigan, New York, Pennsylvania, New Jersey, Connecticut, Massachusetts, Vermont, and the Canadian provinces of Ontario and Quebec.
- Some areas in the United States did not have power for two days and parts of Ontario experienced rotating blackouts for up to two weeks.[6]

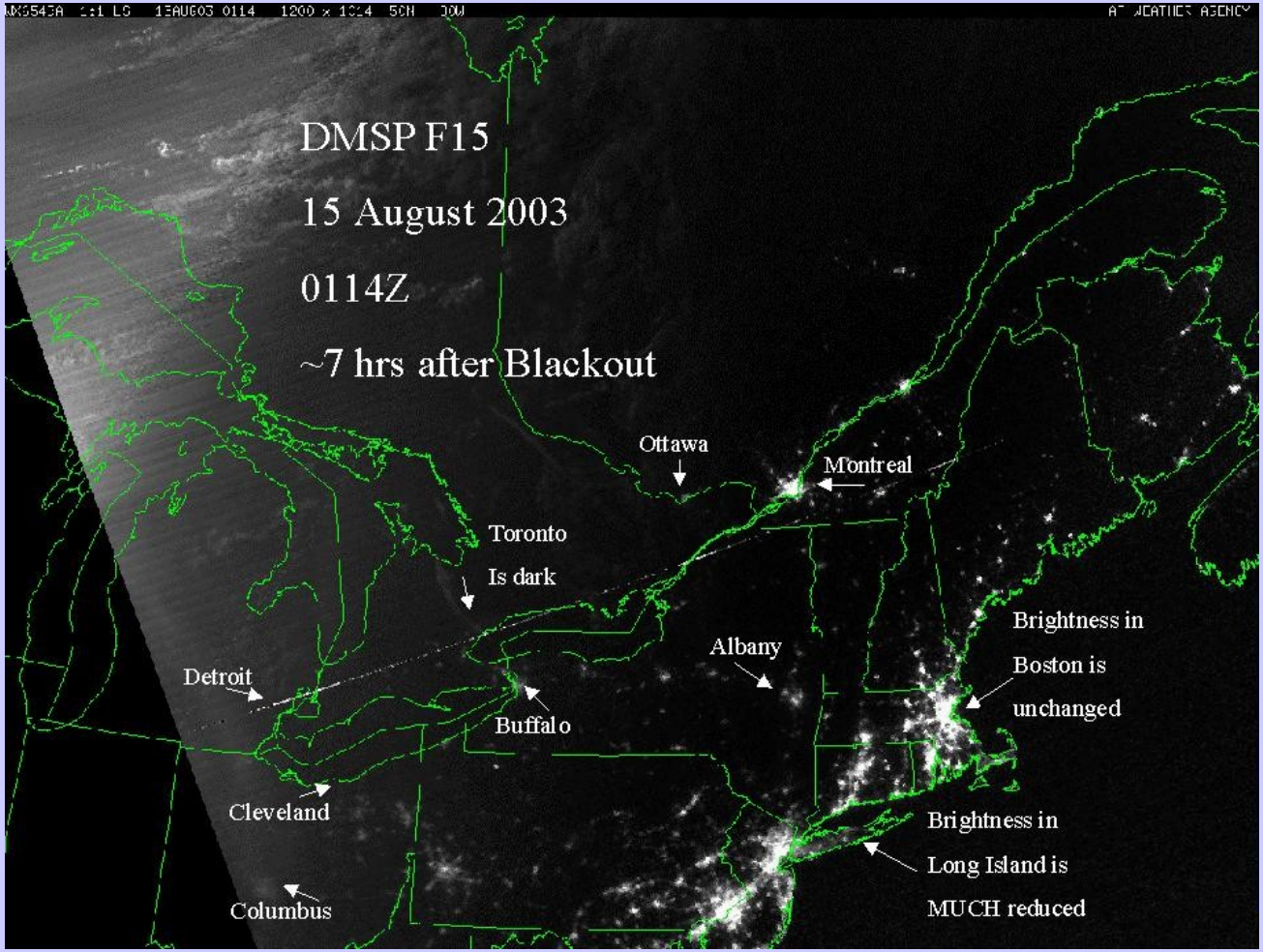
6. http://www.nerc.com/pub/sys/all_updl/docs/blackout/NERC_Final_Blackout_Report_07_13_04.pdf

Satellite Photo Before Blackout



Source: http://www.noaanews.noaa.gov/stories/s2015.htm

Satellite Photo After Blackout



Source: http://www.noaanews.noaa.gov/stories/s2015.htm

Timeline of Events Causing the 2003 Blackout[7]:

- 12:05:44 – 1:31:34 PM – Generator trips
- 2:02 PM – Transmission line disconnects in southwestern Ohio
- 3:05:41 – 3:41:33 PM – Transmission lines disconnect between eastern Ohio and northern Ohio
- 3:45:33 – 4:08:58 PM – Remaining transmission lines disconnect from eastern into northern Ohio
- 4:08:58 – 4:10:27 PM – Transmission lines into northwestern Ohio disconnect, and generation trips in central Michigan
- 4:10:00 – 4:10:38 PM – Transmission lines disconnect across Michigan and northern Ohio, generation trips off line in northern Michigan and northern Ohio, and northern Ohio separates from Pennsylvania
- 4:10:40 – 4:10:44 PM – Four transmission lines disconnect between Pennsylvania and New York

7. From US/Canada Power Outage Taskforce Report found at: http://www.ferc.gov/cust-protect/moi/09-12-03-blackout-sum.pdf

Timeline of Events Causing the 2003 Blackout - Cont'd

- 4:10:41 PM – Transmission line disconnects and generation trips in northern Ohio
- 4:10:42 – 4:10:45 PM – Transmission paths disconnect in northern Ontario and New Jersey, isolating the northeast portion of the Eastern Interconnection
- 4:10:46 – 4:10:55 PM – New York splits east-to-west. New England (except southwestern Connecticut) and the Maritimes separate from New York and remain intact.
- 4:10:50 – 4:11:57 PM – Ontario separates from New York west of Niagara Falls and west of St. Lawrence. Southwestern Connecticut separates from New York and blacks out.
- 4:13 PM – Cascading sequence essentially complete

General Conclusions of the NERC Investigation of the 2003 Blackout:[8]

- Several entities violated NERC operating policies and planning standards.
- Inadequate monitoring of NERC and regional reliability standards.
- Reliability coordinators and control areas adopted differing interpretations of the functions, responsibilities, authorities, and capabilities needed to operate a reliable power system.
- Data used to model loads and generators was inaccurate.
- Planning studies, design assumptions, and facilities ratings were not consistently shared and were not subject to adequate peer review among operating entities and regions.
- Available system protection technologies were not consistently applied.
- Deficiencies identified in studies of prior large-scale blackouts were repeated.

8. http://www.nerc.com/pub/sys/all_updl/docs/blackout/section5.pdf

System Reliability and Security
What are we doing about it now?

FERC opened Electric Reliability Docket (RM04-2-000), updated its strategic plan, and created a new reliability division to ensure the reliability of the bulk electric system.[9]

9. http://www.ferc.gov/industries/electric/indus-act/reliability.asp

System Reliability and Security
What are we doing about it now? Cont'd

FERC held a Technical Conference on 9/29/04. This conference offered a public progress report on the Regional Reliability Readiness Reviews conducted by NERC since the August 14, 2003 blackout.

- 6-10 person audit teams headed by NERC Staff with participants from FERC and other control areas.

FERC's Responsibility Matrix

FERC developed a Responsibility Matrix through the Reliability Readiness Reviews held by NERC. This matrix indicates a set of 21 critical responsibilities for each Control Area or Reliability Authority. For more information please see:

http://www.ferc.gov/EventCalendar/Files/20040929150348-Kueck,%20FERC%20-%20Reliability%20Matrix.pdf

Incentives for TSOs to provide sufficient cross-border capacity

- FERC emphasizes that costing/price signals are needed to provide incentives for transmission expansion to relieve congestion.
  - Locational Marginal Pricing (LMP)[10]
    - serves to balance supply and demand for electric power.
    - provides a comparable basis for pricing transmission use.
    - encourages new generators to locate where the power they produce is of the most value to the load they serve.
    - encourages new loads to consider locations cost-effectively.
    - highlights where new transmission facilities would relieve transmission loading problems on the power grid in the most efficient way possible.
- Need to coordinate siting between jurisdictions
  - FERC long range goal - In every region, have Regional State Committees (RSCs) in place approving annual regional system transmission plans.[11]
  - Many are seeking federal legislation for enhanced FERC siting authority.

10. http://www.spp.org/Market_LMP/lmp/19.html
11. http://www.ferc.gov/about/strat-docs/09-29-03-detail-strategic-plan.pdf, p. 7

Reliability and Operational Rules: Legal Status & Economic Impact Assessment

- RTOs establish, monitor and enforce rules.
- Keep energy infrastructure information secure.
- 12/27/04 FERC order directing specified control area operators and transmission providers to complete a survey on their operator training practices.[12]
- Mandatory reliability legislation is likely to be enacted this year.

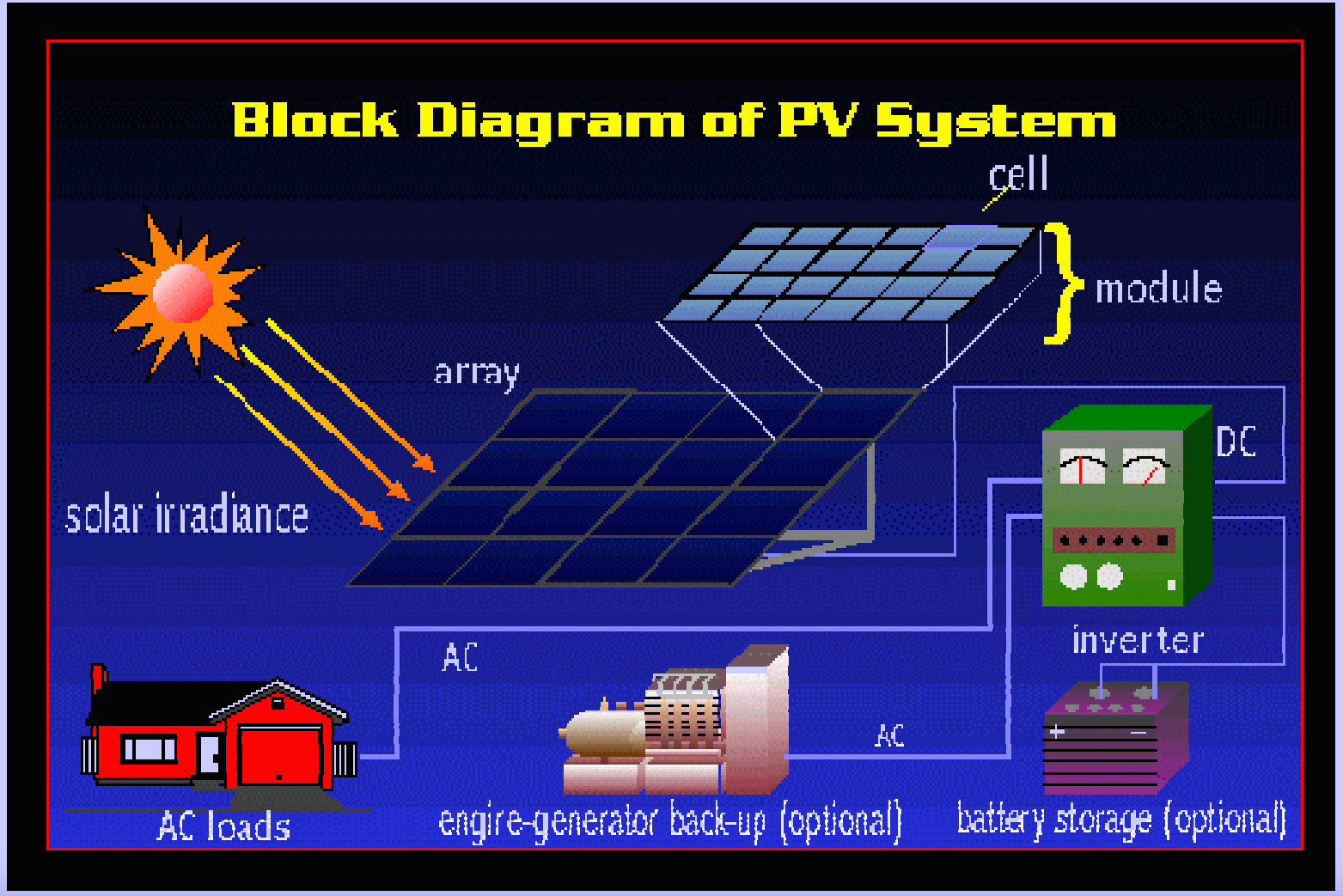
12. http://www.ferc.gov/EventCalendar/Files/20050125085747-EL05-24-001.pdf

Impact of Distributed Generation

Distributed Generation (DG) is the use of small-scale power generation technologies located close to the load being served.

MoPSC's Photovoltaic DG at its Jefferson City, MO Office

Photovoltaic DG Interconnection



Potential Advantages of Distributed Generation[13]

Properly planned and operated DG can provide consumers and society with a wide variety of benefits, including economic savings, improved environmental performance, and greater reliability. Possible impacts of DG:

- Generation located near demand can reduce energy losses.
- Permits utilities to defer upgrades to substations, distribution facilities and transmission facilities.
- Microturbines, turbines, and internal combustion engine generators can provide voltage support and reduce reactive power losses.
- Some DG technologies can gain increased efficiency by taking advantage of waste heat.

13. From National Rural Electric Cooperative Association
http://www.nreca.org/nreca/Policy/Regulatory/Documents/DGWhitepaper.pdf

Potential Advantages of Distributed Generation - Cont'd

- DG powered by renewable resources or fuel cells can substitute for central station generation, resulting in reduced emissions and land-use impacts.
- As the industry restructures, DG can also provide some consumers a "self-help" alternative to volatile markets and market abuses.
- Because they can be faster to build and easier to move; need less existing infrastructure; and require less total (not per KW) up-front capital investment than large central station generators, some DG technologies could have a tremendous role to play internationally in less developed countries.

Interconnection of DG with the electric grid continues to pose genuine safety and reliability risks which must be addressed[14]

- Consumer-owned generation could unexpectedly energize a line that the utility believes is cold, thereby injuring or killing a utility worker or a citizen or starting a fire.
- Given the interconnected nature of the system, every connected generation source affects the system and is affected by the system, regardless of whether it exports power.
- New generation sources can also change the direction and volume of power flows on the system, possibly causing some wires to be underutilized while overloading others. Those changes may require the distribution company to reinforce its system, build new lines, or install new control equipment.

14. From NRECA, http://www.nreca.org/nreca/Policy/Regulatory/Documents/DGWhitepaper.pdf

Conflict between industry stakeholders and other interest groups regarding DG[15]

- Proponents of DG are telling decision makers that utilities and regulators have imposed technical and economic barriers to the development, installation, and interconnection of DG facilities with the electric grid. They are asking regulators and legislators to act to remove those barriers so that consumers can benefit from DG.
- Some utilities (opposed to DG) have insisted that if decision makers adopted the DG proponents' recommendations, it would significantly degrade the safety and stability of electric systems and would require utilities and their residential and small commercial consumers to subsidize uneconomic technology investments by others.
- The electrical grid is very complex and there are too many variations between the different applications of different DG technologies for any one rule to be universally applicable.

15. From NRECA, http://www.nreca.org/nreca/Policy/Regulatory/Documents/DGWhitepaper.pdf

DG – Progress Report

- Recommendations from May 2002 USDOE Grid Study[16]
  - IEEE should expeditiously complete its technical interconnection standards for distributed generation. (IEEE 1547 DG Interconnection Standard released in June 2003)
  - DOE will work with National Governors Association and NARUC to develop and promote the adoption of standard interconnection agreements, rules, and business procedures for distributed generation.
- FERC's Standard Interconnection Agreements and Procedures (FERC Order No. 2003 issued 7/24/03)[17]

16. http://www.eh.doe.gov/ntgs/gridstudy/MAIN_RECOMMENDATIONS.PDF
17. http://www.ferc.gov/whats-new/comm-meet/072303/E-1.pdf and http://www.ferc.gov/industries/electric/indus-act/gi/stnd-gen/order2003-a.pdf

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