Nuclear Power and Communities

Final Presentation
28th April 2009
Dept. of Engineering and Public Policy
Dept. of Social and Decision Sciences
Carnegie Mellon University

Background image: Carnegie Mellon University Center, courtesy of the Master of Software Engineering Program. www.mse.cs.cmu.edu/images/uc.jpg
## Review Panel Members

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<thead>
<tr>
<th>Name</th>
<th>Organization</th>
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<tr>
<td>Mike Anness</td>
<td>Westinghouse</td>
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<tr>
<td>David Hughes</td>
<td>Citizen Power</td>
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<td>Gail Bingham</td>
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<td>Rick Morris</td>
<td>Smith &amp; Harroff Inc.</td>
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<td>Patricia Bonner</td>
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<td>Paul Stern</td>
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<td>Eliot Brenner</td>
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<td>John Gross</td>
<td>DoE</td>
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Purpose of Today’s Meeting

• To describe the project goals

• To present research areas and results

• To suggest policy options
Team Members

Students:
- Tatiana Aguilera
- Katherine Bastine
- Tony De Los Santos
- Catherine Dorsi
- Thomas Fortner
- Brian Gaudio
- Christopher Herlich
- Ashlee Hoffmann
- Ji Soo Jeon
- Chansaly Ker
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- Boo Kim
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- Luke Krzyanowski
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- Amy Maples
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- Shavonne Richardson
- Rusty Sewell
- Nadir Sidi
- Steven Stecker
- Sarah Sukal
- Julia Tischuk
- Jamie Vance
- Tom Whitmore
- Ryan Yates
- Andy Zagoren

Project Managers:
- Nathaniel Travis Heatwole, EPP
- Hari Mantripragada, EPP

Faculty:
- Dr. Keith Florig, EPP
- Dr. Allen Robinson, EPP
What is ‘Project Course’?

• Real world problems with technical, social, and policy dimensions

• 20-30 students work in interdisciplinary groups to structure the problem, collect and analyze the data, and communicate results

• Expert guidance provided by Review Panel

• Advised by two faculty members and two Ph.D. students
Nuclear Power and Communities

- In the coming decade NRC will likely process many applications for new or extended operating licenses

- Next wave of plant construction offers opportunity to rethink society’s approach to utility/community interactions

- Identify trust-enhancing strategies for risk-governance
Project Areas

- Environmental Justice
- Socioeconomics
- Formal Public Involvement
- Informal Community Involvement
- Online Safety Information
- Public Knowledge and Attitudes
- Local Media Content
Project Areas

- Environmental Justice
- Socioeconomics
- Formal Public Involvement
- Informal Community Involvement
- Online Safety Information
- Public Knowledge and Attitudes
- Local Media Analysis
Nuclear Power and Environmental Justice

- Are residents around nuclear power plants poorer than others?
- Is the racial profile around nuclear power plants atypical?

Census Tract Data

Nuclear Plant Locations

Tracts Near Power Plants

Logistic Regression

Results
Investigate Demographics of All Plants
Defining Community for Environmental Justice Analysis

Census Tract
Analyzed Tract
5 mile Radius
Nuclear Plant
Indicator Distribution

Distribution of Median Household Incomes

- Red: Near Power Plants
- Black: Nationwide

Percentage of Tracts

Median Household Income in 1999
# Environmental Justice Indicators

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Economic Indicators</th>
<th>Social Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher Around Nuclear Plant</td>
<td>Income</td>
<td>White Population Black Population</td>
</tr>
<tr>
<td>Insignificant</td>
<td>Working Age Population</td>
<td>Hispanic Population Elderly Population</td>
</tr>
<tr>
<td></td>
<td>High School Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vacant Housing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rental Housing</td>
<td></td>
</tr>
<tr>
<td>Lower Around Nuclear Plant</td>
<td>College Education Poverty</td>
<td>Population Density</td>
</tr>
</tbody>
</table>
Project Areas

✓ Environmental Justice
  o **Socioeconomics**
  o Formal Public Involvement
  o Informal Community Involvement
  o Online Safety Information
  o Public Knowledge and Attitudes
  o Local Media Analysis
Economic Impact Analysis

• What economic effect does a nuclear power plant have on its host community?

• Components
  – Employment
  – Property Taxes
  – Local Purchases
  – Electricity Prices
Employment

Employees Per Reactor at Nuclear Plants

N = 30

<table>
<thead>
<tr>
<th>Employees Per Reactor</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>9</td>
</tr>
<tr>
<td>450</td>
<td>9</td>
</tr>
<tr>
<td>600</td>
<td>4</td>
</tr>
<tr>
<td>750</td>
<td>2</td>
</tr>
<tr>
<td>900</td>
<td>2</td>
</tr>
</tbody>
</table>

Carnegie Mellon
Total Benefit of Plant

Thousands of Dollars/year MWe

- Local Purchases
- Employee Salaries

Coal
Nuclear

$0
$20
$40
$60
$80
$100
$120
$140
$160
$180
$200
Correlation between Energy Prices and Energy Mix

Electricity Price vs Percentage of Energy from Nuclear Power

- Price (in cents/kWh)
- Percentage of Energy Mix from Nuclear Power

p-value = 0.02
Correlation between Energy Prices and Energy Mix

Electricity Price vs Percentage of Energy from Coal

- Price (in cents/kWh)
- Percentage of Energy Mix from Coal Power

p-value = 0.00
Correlation between Energy Prices and Energy Mix

Price vs Percentage of Energy Types

- Coal
- Nuclear

Percentage of Each Energy Source

Price (in cents/kWh)
Demographic Effect of Nuclear Power Plants

• Identify the type of people that live near nuclear power plants

• Test NEI’s statement that nuclear power plants have a significant impact on their host communities over a period of time

• This information can then be used for community consideration when building new plants
Effect of Nuclear Power on Community Demographics

- Total Population
- Workers
  - Construction
  - Utility
  - Service and Professional
  - Public Administration
- Median Household Income
# Summary of Results

<table>
<thead>
<tr>
<th>Category</th>
<th>P-value</th>
<th>Difference of Average Plant and Crown Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population</td>
<td>0.13</td>
<td>10,600</td>
</tr>
<tr>
<td>Construction</td>
<td>0.22</td>
<td>-850</td>
</tr>
<tr>
<td>Utilities</td>
<td>0.29</td>
<td>-490</td>
</tr>
<tr>
<td>Professional and Related Services</td>
<td>0.31</td>
<td>707</td>
</tr>
<tr>
<td>Public Administration</td>
<td>0.39</td>
<td>41.3</td>
</tr>
<tr>
<td>Median Household Income</td>
<td>0.33</td>
<td>588</td>
</tr>
</tbody>
</table>
Summary of Findings

• Nuclear power plants are not an environmental justice issue

• Nuclear power plants offer more jobs at higher salaries, but more coal power results in lower energy prices to the consumer

• A nuclear power plant does not have any noticeable effect on a community’s demographics
Project Areas

✓ Environmental Justice
✓ Socioeconomics
○ Formal Public Involvement
○ Informal Community Involvement
○ Online Safety Information
○ Public Knowledge and Attitudes
○ Local Media Analysis
Goals of Formal Involvement

• What is formal involvement?

• How effective are these programs in integrating the community?

• Recommendations for improvement
Processes

EIS Comments

- Generic EIS provided
  - Comments Accepted
    - Do not appear in Final EIS
    - Appear in Final EIS
  - Comments Rejected
    - Petitioner is Notified

Enforcement Petitions

- Submit Petition Request
- Executive Director Refers to Appropriate Office Director
- Director Determines if Request Meets Criteria
  - Yes
    - Director Issues Decision
    - Grants Action
    - Denies Action
    - Grants in Part
  - No
    - Petitioner is Notified
Methodology

**EIS Comments**
- Reviewed EIS comments for 4 plants
- Separated into two categories; accepted and rejected
- Reviewed whether accepted comments were in final EIS

**Enforcement Petitions**
- Quantified success rate of both submitted requests and reviewed requests
- Reviewed all director’s decisions between 2000-2008
- Categorized petitions by subject
Results

**EIS Comments**
- 66% Comments Declined
- 34% Comments Accepted

**Enforcement Petitions**
- 70% Petition Requests Declined
- 8% Petition Requests Granted
- 22% Petition Requests Partially Granted
Conclusions & Recommendations

• Conclusions
  – Acceptance rate for comments and petitions are low
  – Additional personal interaction is required between community members and NRC

• Recommendations
  - Need NRC office to assist the public in formulating comments and petition requests
Reactor Oversight Program

- Findings issued quarterly
- Green is good
- Increasing severity: White, Yellow, Red
- Analyze trends in ROP findings since program began in 2000
  - Looking for industry-wide trends
  - Comparison across corporate owners
National Trend in ROP Findings

- Overall decreasing trend in white findings
- Evidence that the ROP is working?
Corporate Performance Benefit

![Graph showing the relationship between negative findings per reactor and the number of reactors owned. The graph includes two lines: one representing the average white reactor and another representing the average yellow reactor.](image-url)
Project Areas

✓ Environmental Justice
✓ Socioeconomics
✓ Formal Public Involvement
  o **Informal Community Involvement**
  o Online Safety Information
  o Public Knowledge and Attitudes
  o Local Media Analysis
Informal Community Involvement Purposes

- To identify current interaction methods
- To assess nuclear plant contact availability to the community
- To gain insight into plant and community interaction
Interview Plant Locations

Region I: Limerick, Seabrook, Three Mile Island
Region II: Oconee, Surry, Turkey Point
Region III: Byron, Davis-Besse
Region IV: Columbia Generating, Comanche Peak, Palo Verde, Victoria

Existing Plants
Proposed Sites

Interview Methodology

- Different question sets
- Compare interactions to public participation spectrum

- Local Community
  - Community Group Members
  - Newspaper Editors

- Nuclear Power Plant
  - Communications Managers
  - Public Affairs Managers

- Local Government
  - Township Managers
  - Mayors
  - Emergency Planning Coordinators

Contacts Made
Spectrum of Public Participation

- Empower
  - Radiation Detection by Community
- Collaborate
- Involve
  - Polling
  - Local Government Property Tax Negotiations
- Consult
  - Feedback Forms
  - Community Panel
- Inform
  - Educational Programs
  - Plant Tours
  - Published Information
  - Information Center
  - Public Presentation
Web Based Plant Contact Availability

N=65
Policy Recommendations

Empower
Collaborate
Involve
Consult
Inform

Increasing Level of Public Impact

Offer an Ongoing Community Forum

Publication of Minimum Contact Information

Creation of a Site Specific Community Director

Creation of Involvement Standards for all Operators
Project Areas

- Environmental Justice
- Socioeconomics
- Formal Public Involvement
- Informal Community Involvement
  - Online Safety Information
  - Public Knowledge and Attitudes
  - Local Media Analysis
Assessing Availability of Online Safety Information

**Goal**: To examine ways safety information is communicated to the public via the Internet

- Evaluating the availability of safety information on power plant websites and the NRC website.

- Critiquing the NRC website’s ability to communicate safety related information to the public.
Plant Website Evaluation Methodology

- Evaluate websites in each category
- Assign weight to each category
- Total weighted scores for overall grade
Evaluate Websites in Each Category

<table>
<thead>
<tr>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Preparedness</td>
</tr>
<tr>
<td>Emergency Response</td>
</tr>
<tr>
<td>Security</td>
</tr>
<tr>
<td>Contact Information</td>
</tr>
<tr>
<td>Hazardous Material Storage</td>
</tr>
<tr>
<td>Design Safety</td>
</tr>
<tr>
<td>Maintenance</td>
</tr>
<tr>
<td>NRC Link</td>
</tr>
</tbody>
</table>

Grades:
0 = No Mention
1 = Some Coverage
2 = Good Coverage
Good Emergency Preparedness Information – Indian Point, NY

Abundant Safety Systems at Indian Point

The Indian Point plants are designed with abundant safety systems and multiple components to prevent accidents. And, no matter how unlikely the chances of an accident affecting the public may be, a significant investment of time and resources has gone into ensuring that everyone within the Emergency Planning Zone (EPZ) has the information they need to respond safely and appropriately. The physical manifestation of this collaborative public-private effort is in the Emergency Planning Guide that you receive in the mail each year. You may also access .pdf versions of these guides in the EPZ section of our website. And, emergency planning resources are offered by New York State and the Red Cross.

Below are answers to some of the most pressing emergency planning questions. If you do not find the answers you are looking for, please contact us for additional information.

<table>
<thead>
<tr>
<th>How You Will Be Notified Of An Emergency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Alert System (EAS)</td>
</tr>
<tr>
<td>The Four Emergency Levels</td>
</tr>
<tr>
<td>What protective action should I take?</td>
</tr>
<tr>
<td>Sheltering Instructions</td>
</tr>
<tr>
<td>Evacuation</td>
</tr>
<tr>
<td>General Population Reception Centers</td>
</tr>
<tr>
<td>Evacuation Routes and Transportation</td>
</tr>
</tbody>
</table>

Grade = 2 !!!

Plant Website Evaluation Methodology

Evaluate websites in each category

Assign weight to each category

Total weighted scores for overall grade
All Categories Are Not Equally Important

Category score
(Weight) x Grade [0, 1, 2]

EM prep. Score for Indian Point
= 0.19 x 2
Plant Website Evaluation Methodology

1. Evaluate websites in each category
2. Assign weight to each category
3. Total weighted scores for overall grade
Plant Websites Have Room for Improvement

Median = 44.3

Indian Point
The Strengths and Weaknesses of Plant Websites

- EM Preparedness
- Storage
- Env. Impact
- Security

- Good Coverage
- Some Mention
- No Mention
Evaluating the NRC Website

- Use of Text
- Design and Usability Dimensions
- Layout
- Graphics
- Colors & Styles
- Font Sizes
NRC Website

Current Action Matrix Column:
Licensee Response

Assessment Reports

Reactor Safety
- Initiating Events
- Mitigating Systems
- Barrier Integrity
- Emergency Preparedness

Radiation Safety
- Occupational Radiation Safety
- Public Radiation Safety

Safeguards
- Security
Conclusions and Recommendations

- Nuclear plants are under-utilizing the web to communicate important information.

- The NRC should use good web design to create a more effective website.

- Ultimate goal should be a cooperative, super-site that interlinks the plant websites and the NRC site.
Project Areas

☑ Environmental Justice
☑ Socioeconomics
☑ Formal Public Involvement
☑ Informal Community Involvement
☑ Online Safety Information
☑ Public Knowledge and Attitudes
  o Local Media Analysis
Objective

To determine the general knowledge and attitudes of the population about the nuclear power industry and its relations with the community.

Method Used:

- Created a 32 question survey
- Focus Areas
  - Knowledge
  - Community Involvement
  - Attitudes
  - Comparison to other facilities
Selected Results

• Nuclear Power Preference vs. Knowledge of Nuclear Power

• What are people’s preferences for
  - Siting processes?
  - Addressing community safety concerns?
Survey Populations

• Carnegie Mellon University (CMU)
  – Mostly students between the age of 18-25
  – Total count: 85

• Greater Pittsburgh Area
  – Evenly distributed in age and gender
  – Total count: 40

• Beaver Valley Area
  – Evenly distributed in age and gender
  – Total count: 50
Knowledge of Nuclear Power

Examples of Questions Asked:

1. Nuclear Power plants produce about 20 percent of the United States electricity.

   TRUE          FALSE

2. The NRC has a procedure by which ordinary citizens can petition it to address specific safety problems at a particular power plant.

   TRUE          FALSE
Measuring Relative Preference for Nuclear Power

Question Asked:

The United States currently needs to build 100 new power plants to replace older power plants and keep up with the growing electricity needs of the nation. The two options for power plants are coal powered and nuclear power.

___ Coal Powered Plants + _____ Nuclear Powered Plants = 100 Power Plants
Knowledge vs. Nuclear Power Preference

- Beaver Valley
- CMU & PGH
- All Populations
Interactions with a Proposed Nuclear Power Plant

Example of Question Asked:

Leave it up to the federal and state government to decide, whether or not the design of the proposed power plant follows the national regulations for safety, security, and environmental protection.

1 2 3 4 5 6 7
Strongly Neutral Strongly
Opposed Support
Overall Perceptions on Proposed Site Options

Options Asked:

- Randomly-Chosen Citizen Board
- Town Hall Debate/Decision
- Public Debate w/Opinion Poll
- Referendum Vote
- Federal/State Decision

Percentage Response

- Negative Response
- Neutral Response
- Positive Response
Location Specific Perceptions on Proposed Power Site
Public Perceptions of Measures Reducing Community Safety Concerns

Question Asked:

Please rank in order of best to worst the following measures a nuclear power plant could take to reduce the communities safety concerns.

Provide funds to the county to have an independent radiation monitoring system.
Responses To Measures to Address Public Safety Concerns

Options Asked:

- Expanding Emergency Response
- Quarterly Mailings
- Free Plant Tours
- Website with current plant information
- Independent Radiation Monitor
- Webcam of Control Room

The chart shows the percentage response to each measure, categorized as negative, neutral, or positive responses.
Summary of Key Findings

- Preference for nuclear power is correlated with knowledge however causal direction is unknown

- People prefer more democratic ways of resolving siting issues

- People prefer options that allow them to ‘feel’ in control
Project Areas

- Environmental Justice
- Socioeconomics
- Formal Public Involvement
- Informal Community Involvement
- Online Safety Information
- Public Knowledge and Attitudes
  - Local Media Analysis
Is Print and TV Media Giving Citizens Fair and Balanced Info on Nuclear Power?
Analysis Methodology

Subject Completeness
- Type of Site
- Media Outlet

Bias?
- Type of site
- Headline vs. Body
Data Sources

Existing Sites
- Beaver Valley, PA
- Diablo Canon, CA

New Reactor Licenses
- Scottsboro, AL
- Oswego, NY
- Comanche, TX

Proposed Sites
- Victoria, TX
- Levy County, FL
- Cherokee, SC

Sources:
Newspaper: (142 articles)
Television: (86 transcripts)
Subject Completeness

Television Transcripts

- Community involvement
- Transportation
- Environmental effects
- Licensing/legal
- Waste disposal
- Rules and regulations
- Economics
- Safety

Newspaper Articles

- existing sites
- new reactor licenses
- proposed sites

Type of Site

% of Coverage

Existing Sites New Reactor Sites Proposed Sites
Bias by Type of Site?
Bias: Headline vs. Content

Cumulative Distribution of Valence for 109 Print Articles

Fraction of articles with valence ≤ X

Valence

Content
Headlines
Conclusions

Local news coverage on nuclear power would better serve their communities if:

1) Covered more subjects of nuclear power than just safety and economics;
2) Coverage is neutral and objective as possible by presenting both sides of arguments about the local nuclear power plant;
3) provides more consistent and cohesive information valence within headlines and contents.
Overall Project Conclusions

• The nuclear industry and nuclear regulators have made progress over the years in addressing the communication and information needs of nuclear host communities.

• Additional measures to involve the public in more substantial and empowering ways could improve citizens’ sense of control over their personal risk, and bank trust for the inevitable future episode when risk management systems fail.

• Many of these measures, such as website enhancement and dedicated plant-specific community contacts, have modest cost.
Thank You