

Thirty Years Later, Would We Have Done Anything Different?

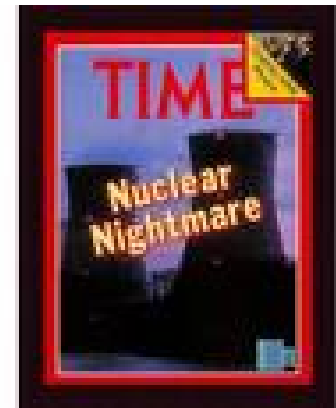
Reflections on the Findings of the President's Commission on the Accident at Three Mile Island

Carol D. Berger
Integrated Environmental Management, Inc.

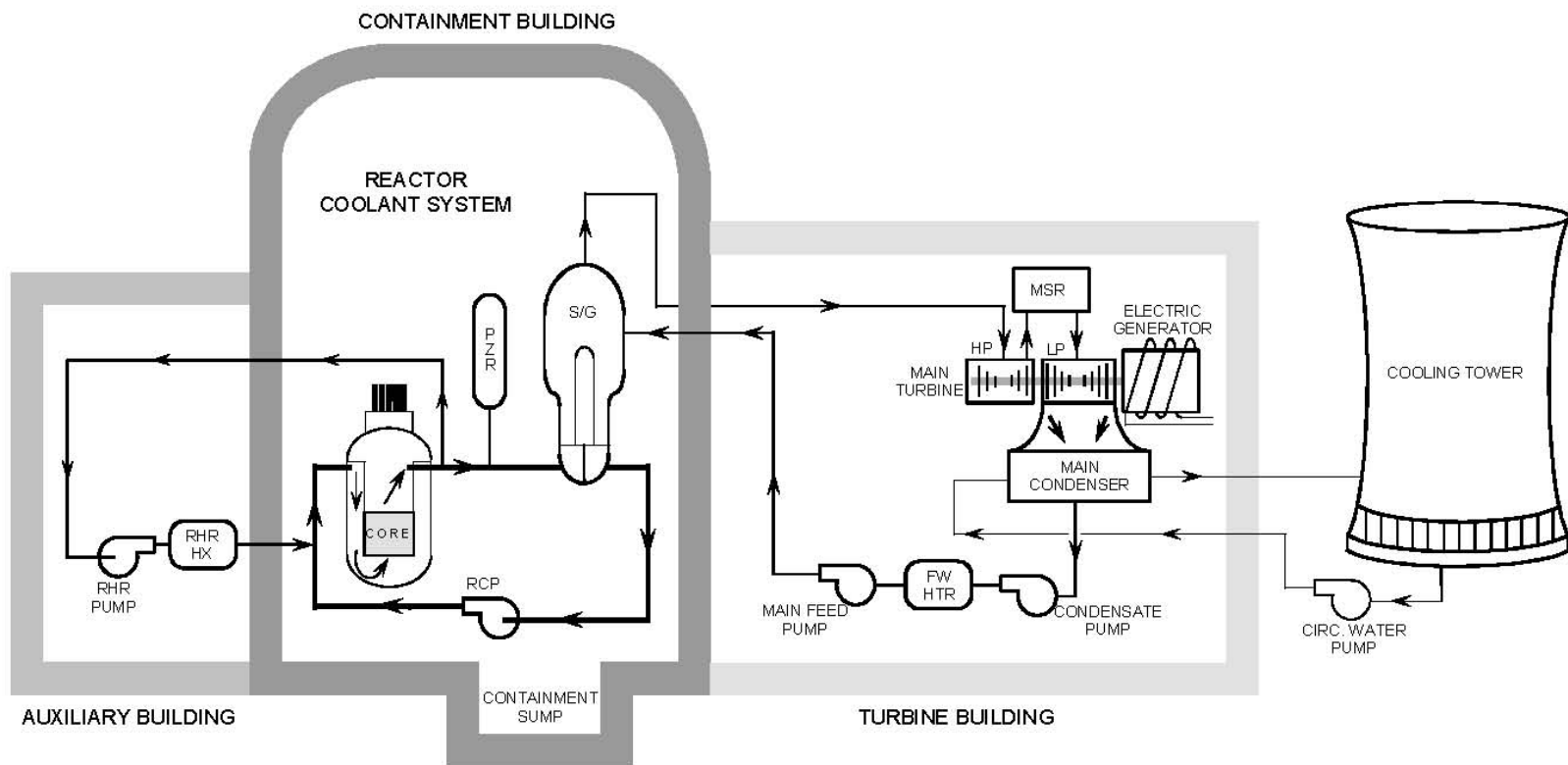


It Seems Like Just Yesterday

- March 28, 1979, between 4:00 and 6:00 a.m., reactor coolant pressure at a Pennsylvania reactor begins to drop.
- Health physicists around the world felt a *cold chill* running down their spines.
- Later that evening, the first news reports hit the airwaves . . .



Commercial Power Reactor



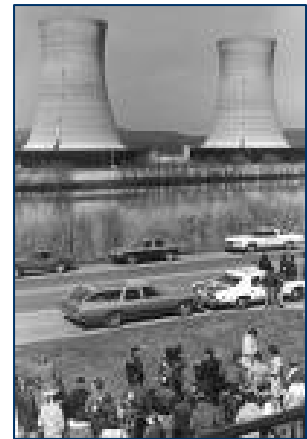
What Happened

- Feed water pumps stopped running (mechanical or electrical failure)
- Reactor automatically shut down/ECC turned on.
- Pressure rose and relief valve opened.
- Confusion in the control room led to decision to turn off ECC.
- Fuel overheated, pellets began to melt.
- *More confusion led to removal of water from reactor sump to Auxiliary Building.*
- Sixteen hours later, core was flooded and temperature brought under control.
- Two days later (“Black Friday”) Governor ordered evacuation.
- Five days later, the crisis is officially over.



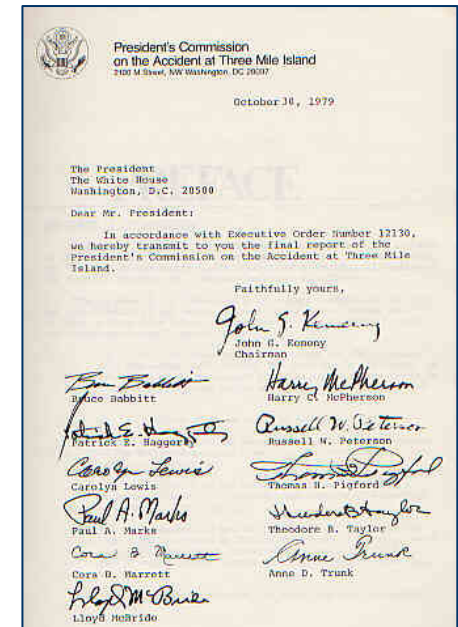
What Happened Next . . .

- Authorities were caught off-guard when radioactive gases were measured off-site.
- Assessment teams from everywhere mobilized to the site.
- “Billions and billions” of studies were initiated.
- *The President of the United States took notice.*



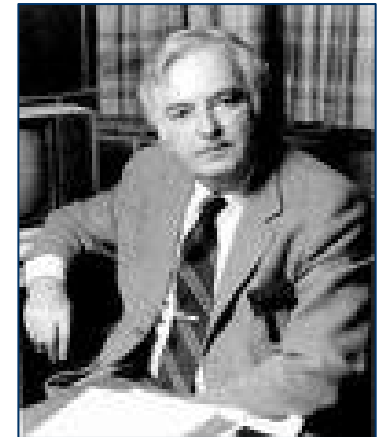
Birth of a Presidential Commission

- By April 13, 2009, a 12-member Commission was charged (Executive Order 12130).
- Objective was to “conduct comprehensive study and investigation of the recent accident involving the nuclear power facility on Three Mile Island”:
 - Assessment of events and causes, including health/safety of public and workers;
 - Analysis of the role of the managing utility;
 - Emergency preparedness and response of NRC, State and other authorities;
 - Evaluation of NRC’s procedures as applied to the facility;
 - How the public’s right to information was served;
 - Appropriate recommendations based on the Commission’s findings.



The President's Commission on the Accident at Three Mile Island

- **John G. Kemeny, Chairman (President, Dartmouth College)**
- Bruce Babbitt (Governor of Arizona)
- Patrick Haggerty (Honorary Chairman Texas Instruments)
- Carolyn Lewis (Professor of Journalism, Columbia University)
- Paul Marks (VP for Health Sciences, Columbia University)
- Cora Marrett (Professor of Sociology and African Studies, University of Wisconsin-Madison)
- Lloyd McBride (President, United Steelworkers of America)
- Harry McPherson (Partner, Verner Liipfert Bernhard and McPherson)
- Russell Peterson (President, National Audubon Society)
- Thomas Pigford (Professor of Nuclear Engineering, University of California at Berkeley)
- Theodore Taylor (Visiting Lecturer, Department of Mechanical and Aerospace Engineering, Princeton University)
- Anne Trunk (Resident, Middletown, Pennsylvania)



Commission Task Forces

- Technical Assessment Task Force (Leonard Jaffe)
- **Public Health and Safety Task Force (Jacob Fabrikant)**
 - Radiation Health Effects
 - Health Physics and Dosimetry
 - Public Health and Epidemiology
 - Behavioral Effects
- Emergency Preparedness and Response Task Force (Russell Dynes)
- Public's Right to Information Task Force (David Rubin)

OFFICE OF THE DIRECTOR OF TECHNICAL STAFF

Vincent L. Johnson, Director of Technical Staff

Technical Assessment Task Force

Leonard Jaffe, Head
William M. Bland, Jr.
Robert English
Ronald M. Eytchison
Dwight Heilly
William Stratton
Jasper L. Tew

Public Health and Safety Task Force

Jacob I. Fabrikant, Head
Lloyd Corwin, Advisory/Administrative Associate
John A. Auxier, Head, Health Physics and Dosimetry Task Group
George W. Casarett, Head, Radiation Health Effects Task Group
Paul M. Densen, Head, Public Health and Epidemiology Task Group
Bruce F. Dohrenwend, Head, Behavioral Effects Task Group

Emergency Preparedness and Response Task Force

Russell R. Dynes, Head
Quinten Johnson
Arthur H. Purcell
Robert Stallings
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Public's Right to Information Task Force

David M. Rubin, Head
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Ann Marie Cunningham
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Nancy C. Joyce
Mary Paden
Roy S. Popkin
Peter M. Sandman
Mark C. Stephens
Mitchell Stephens
Patricia E. Well
Emily Wells



Health Physics and Dosimetry Task Group

- **John A. Auxier, Head (Oak Ridge National Laboratory)**
- Carol D. Berger (Oak Ridge National Laboratory)
- Charles M. Eisenhauer (National Bureau of Standards)
- Thomas F. Gesell (University of Texas)
- Alun R. Jones (Atomic Energy of Canada Ltd. Chalk River)
- Mary Ellen Masterson (Memorial Sloan Kettering Institute)

<u>Consultants to the Public Health and Safety Task Force</u>
James F. Crow David A. Hamburg Henry S. Kaplan Walsh McDermott
<u>Consultants to the Health Physics and Dosimetry Task Group</u>
Carol D. Berger Charles M. Eisenhauer Thomas F. Gesell Alun R. Jones Mary Ellen Masterson
<u>Consultants to the Radiation Health Effects Task Group</u>
Seymour Abrahamson William J. Bair Michael A. Bender Arthur D. Bloom Victor P. Bond
<u>Consultants to the Public Health and Epidemiology Task Group</u>
David Axelrod Maura S. Bluestone Eugene W. Fowinkle Kenneth G. Johnson Ellen W. Jones Raymond Seltzer
<u>Consultants to the Behavioral Effects Task Group</u>
Barbara S. Dohrenwend Stanislav V. Kozl George J. Warheit
<u>Consultant to the Emergency Preparedness Task Force</u>
John Ruch
<u>Consultants to the Public's Right to Information Task Force</u>
Alton Blakeslee Hillier Krieghbaum Howard J. Lewis



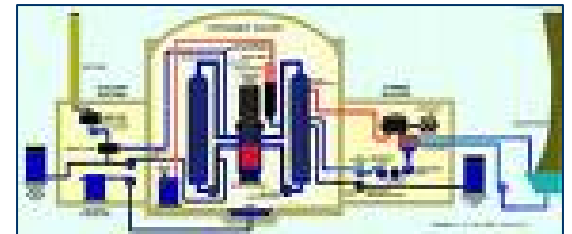
Task Group Directives

- Sequence of events.
- Assessment of radioactivity released.
- Population doses based on radioactivity released. Population doses based on TLD measurements.
- Analysis of doses from inhaled and ingested radioactivity.
- Analysis of doses received by plant personnel.
- Review of radiation safety procedures in effect at the time of the accident.



Assessment of Radioactivity Released

- Stack monitor quickly went “off scale”.
- Estimate to date, from stack monitor and area surveys, was 35 million curies of noble gases released.
- Stack monitor and nearby gamma monitor at base of stack used for data.
- We estimated 2.5 million curies of noble gases released.
- We thought we were wrong, but stood by our guns.



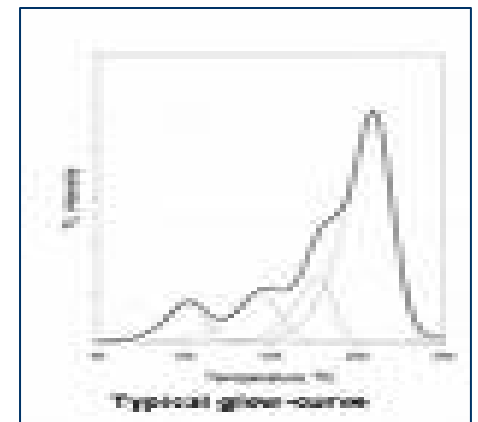
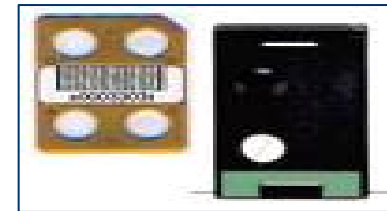
Population Doses Based on Radioactivity Released

- Used Task Group estimate of release and local meteorology.
- Three dispersion models used for time period between 3/28 to 4/15/78 (95% thought to be experience in this interval).
- Most likely collective dose within 50-mile radius was 500 person-rem (1 mrem average individual).
- Most likely maximum individual dose was 20 to 70 mrem.



Population Doses Based on TLD Measurements

- Thermoluminescent dosimeters (TLD) from multiple organizations (20 stations) deployed around the plant at time of accident.
- On day 3, Federal agencies deployed more (USNRC, 47; BRH, 237; USEPA, 59 stations).
- Population distribution projected from 1970 census data.
- Sheltering taken into account; interpolated between stations.
- Most likely collective dose within 50-mile radius was 2,800 person-rem (1.3 mrem average individual).
- Most likely maximum individual dose, 50 mrem.



Doses Received by Plant Personnel

- External doses assessed from TLD (results viewed with caution).
- Internal doses assessed from whole body counting (results highly questionable).
- During March: 221 workers within 0.5 to 3 rems; 3 workers within 3 to 5 rems; none over 5.
- During April: 49 workers within 0.5 to 3 rems; none over 3 rems.
- During May: 7 workers within 0.5 to 3 rems; none over 3.



Reassessments Since 1980

- **USNRC/USEPA Studies** – “Average dose to about 2 million people in the area was only about 1 millirem; the maximum dose to a person at the site boundary would have been less than 100 millirem.”
- **TMI Litigation Experts** – “The actual dose received by any one person will never be known, but limits are in the 25 to 50 mrem range.”
- **American Nuclear Society** – “The average radiation dose to people living within 10 miles of the plant was 8 millirem, and no more than 100 millirem to any single individual.”

HP&D Task Group:

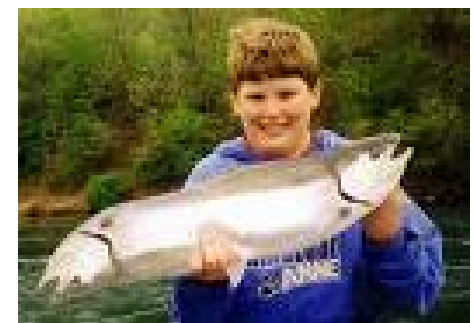
Average dose:
20 mrem, 1-10 miles;
6.5 mRem, 10 – 50
miles;
1 millirem, 50 miles

Maximum individual
dose:
70 mrem



Interpreting the Data

- **Wing Study** (1975 to 1985) – “Radiation accident increased cancer in areas that were in the path of radioactive plumes.”
- **University of Pittsburgh Study** (1979 to 1988) – “This survey of data confirms our earlier analysis that radioactivity released during the nuclear accident at TMI does not appear to have caused an overall increase in cancer deaths among residents of that area.”



What Would We Have Done Different?

- Nothing!
- We needed every minute of the six-months it took to collect, digest, interpret and present the data.
- All things considered, 1979 release and dose estimates remain valid.
- The reactor worked just fine, thank you very much!
- Other than stress, no injuries or detectable health impacts from the accident.
- Ramifications of the accident on the US nuclear power program were significant.



Personal Lesson Learned:

- Skylab (space station) was abandoned in 1974.
- Headed to earth some time in July of 1979.
- Buried in the 418-page Task Group Report, in the Sequence of Events section: “On May 1, 1979, a piece of Sky Lab lodged into the Auxiliary Building stack, ended any further release of radioactivity from the Three Mile Island Plant.”
- My lesson learned . . . Some people are *very good* at proof-reading!





About the Speaker:

Carol D. Berger is Certified by the American Board of Health Physics, a Fellow member of the Health Physics Society and has over 32 years experience in nuclear activities with emphasis in strategic planning, radiation dosimetry, instrumentation, and applied health physics. She is Past-President of the American Academy of Health Physics, past member of the Panel of Examiners for the American Board of Health Physics, Past President and Past Secretary of the East Tennessee Chapter of the Health Physics Society, and Director and Past Treasurer of the Baltimore-Washington Chapter of the Health Physics Society. She is a recognized expert in the fields of external and internal dosimetry, having participated on several ANSI, ASTM, and NCRP committees for establishing dosimetry standards. Prior to her current position as President of Integrated Environmental Management, Inc. (IEM), a 100% woman-owned and operated small business, she served as a senior technical consultant for IT Corporation, head of the Radiation Dosimetry Group at Oak Ridge National Laboratory, adjunct teaching staff at Oak Ridge Associated Universities, and was a member of the Health Physics and Dosimetry Task Group for the President's Commission on the Accident at Three Mile Island.

Questions?

Carol D. Berger

Integrated Environmental Management, Inc.

8 Brookes Avenue, Suite 205

Gaithersburg, Maryland 20877

(240) 631-8990 – cdberger@iem-inc.com

www.iem-inc.com

