Helping the Public Understand all security issues:  

*Environmental Security*  
*Energy Security*  
*Economic Security*  
*National Security*  
*Nuclear Non-Proliferation*

Only a correct energy mix will approach total security

James Conca, Director  
Carlsbad Environmental Monitoring and Research Center  
New Mexico State University
WIPP’s opening was almost accidental

James Conca, Director
Carlsbad Environmental Monitoring and Research Center
New Mexico State University

GoNERI Meeting
Januar 16, 2009
Santa Fe
Environmental Monitoring of WIPP

26,000 ft² NMSU radiochemistry facility

- Environmental, radiochemistry and separations laboratories: perchloric acid hoods, IC, ICP-MS/OES, GC-MS, VOCs

- A plutonium-uranium lab and counting labs: over 100 α-specs, germanium γ-specs, gas proportional counters and liquid scintillation counters, UV-Vis spectroscopy, Nd–YAG laser, XRD, UFA

- Bioassay facility with whole body dosimetry
Routine Analyses

◆ **Radionuclides** (generally to femtoCurie levels)
  - $^{228}$Ac, $^{241}$Am, $^7$Be, $^{212}$Bi, $^{213}$Bi, $^{214}$Bi, $^{144}$Ce, $^{249}$Cf, $^{60}$Co, $^{134}$Cs, $^{137}$Cs, $^{152}$Eu, $^{154}$Eu, $^{40}$K, $^{234m}$Pa, $^{233}$Pa, $^{210}$Pb, $^{212}$Pb, $^{214}$Pb, $^{106}$Ru, $^{125}$Sb, $^{90}$Sr, $^{208}$Tl, $^{235}$U, $^{241}$Am, $^{238}$Pu, $^{239,240}$Pu, $^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, $^{238}$U (and enrichment factors, HAT)

◆ **Inorganics**
  - As, Ba, Be, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Hg, K, La, Li, Mg, Mn, Mo, Na, Nd, Ni, Pb, Pr, Sb, Sc, Se, Si, Sm, Sn, Sr, Th, Ti, Tl, U, V, Zn
  - Chloride, Fluoride, Nitrate, Nitrite, Phosphate, Sulfate

◆ **Organics**
  - VOCs, head space gases, flammables

◆ 17 radionuclides monitored in lung and whole body (MDE < 6 keV)

◆ Other material properties ($K$, $\theta$, $G$, $D$, $\kappa$, $n$, etc.)
Public Surveys

- Mid-1990’s surveys showed public most concerned about:
  1. Air
  2. Whole body
  3. Drinking water
  4. Soil, surface water and sediment (distant fourth)

Therefore, the monitoring focuses on fixed air samplers for air coming out of the mine (daily), whole body counting of area citizens and workers (as often as desired for citizens and annually/semi-annually as required for workers), and ambient aerosol collection of outside air (monthly). Drinking water, soils, surface waters and sediments are collected in alternate years.

All results are made public through reports and website
Ambient Aerosol Studies

$^{239,240}$Pu variability tied to seasonal dust cycle (coupled to [Al]); same for $^{241}$Am

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![Map of vicinity of WIPP](image)
Daily monitoring of WIPP Underground Air using On-Site Fixed Air Samplers

Activity variability from both alpha and beta follows seasonal cycles
Plutonium-239 in Carlsbad Drinking Water 1998-2005

$^{239,240}\text{Pu}$ in Carlsbad drinking water from 1998 to 2005. MDC is the minimum detection concentration, and all samples are below this lower limit. EPA Action levels are for all alpha-emitters, including $U+\text{Pu}$. 

EPA Drinking Water Action Level = 15 pCi/L = 0.56 Bq/L
Lie Down & Be Counted Program

- State-of-the-art *in vivo* bioassay (lung & whole body) facility
  - DOELAP accredited *in vivo* bioassay service laboratory for WIPP
  - Provide *in vivo* bioassay services for commercial entities
- Recruit citizen volunteers from the area surrounding WIPP
  - Standard 30 minute *in vivo* bioassay measurement
  - Screen for over 30 natural and anthropogenic gamma & x-ray-emitting radionuclides
  - Only nuclear facility in the world with a “before and after” on its population (before and after WIPP opened)
Lie Down & Be Counted Program

- ~700 individuals recruited since July 1997
  - 40 new volunteers since monitoring program resumed in FY05
- Over 930 total counts performed, including recounts
- 367 volunteers counted prior to WIPP receiving waste; these serve as a “baseline”
  - As of December 2006, operational monitoring results for all radionuclides were consistent with the baseline results.
  - No evidence of a change in the frequency of detection since WIPP began receipt of radioactive waste.

- Cs-137 detected in over 20% of individuals
- In addition, over 3,000 workers have been counted as part of work for WIPP contractors
Every town and city along all WIPP transportation routes have been provided radiation and nuclear hazard response training (over 30,000 fire, police and medical first responders).
Radiation Dispersal Devices (RDDs) and the Need for Rapid Response

CEMRC NMSU
<table>
<thead>
<tr>
<th>Day</th>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>Tue</td>
<td>Radiological basics</td>
</tr>
<tr>
<td></td>
<td>Radioactive materials and availability</td>
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<tr>
<td></td>
<td>Hazard recognition/Protective measures</td>
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<tr>
<td>lunch</td>
<td><em>Dirty War</em> (BBC/HBO movie)</td>
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<td></td>
<td>Initial response</td>
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<td></td>
<td>Patient handling</td>
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<tr>
<td></td>
<td>Radiological Survey Instruments Overview</td>
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<td></td>
<td>Packaging, transportation and smuggling</td>
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<tr>
<td>Wed</td>
<td>Introduction to Dirty Bombs</td>
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<td></td>
<td>Decon and Pre-hospital practices</td>
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<td></td>
<td>Crime scene preservation</td>
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<tr>
<td>lunch</td>
<td></td>
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<tr>
<td></td>
<td>Chernobyl and Goiania</td>
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<tr>
<td></td>
<td>Transportation</td>
</tr>
<tr>
<td></td>
<td>Incident Command and Control/Public Information</td>
</tr>
<tr>
<td>Thu</td>
<td>Downhole into WIPP</td>
</tr>
<tr>
<td>lunch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practical Field Exercise</td>
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</tbody>
</table>
What are the risks to responders working in the hot zone?

Relative risks to first responders:

- **10 rem acute dose**
  - In the working hot zone for a day - no measurable health effects ever reported for 10 rem
    - Fighting a dumpster fire
    - Hand-cuffing an inebriated nuisance

- **25 rem acute dose**
  - In the working hot zone for a few days
    - Fighting a three-alarm fire from the street
    - Disarming a perpetrator who has no weapon

- **50 rem acute dose** (DHS responders suggested upper limit for saving life in large numbers)
  - In the working hot zone for a week
    - Running into a burning building not at risk of collapse
    - Disarming a perpetrator who has a knife

- **100 rem acute dose**
  - In the working hot zone (0.1 to 1 rem/hr) for a month/~10 min priority rescue at Grnd 0
    - Running into a burning building at risk of collapse
    - Disarming a perpetrator who has a gun
LNT

Reality?

Real data

Reality?
The 111th Congress will have a new Senate Nuclear Caucus

Majority Lead: Senator Mary Landrieu (D-LA)
Minority Lead: Senator George Voinovich (R-OH)

Others:
- Senator Evan Bayh (D-IN)
- Senator Jim Webb (D-VA)

With Reid and Obama set to kill Yucca Mountain and re-write the Nuclear Waste Policy Act, WIPP and the Salado Salt must be in the forefront of discussion in this new Nuclear Caucus.
The GeoPolitics of Energy
Achieving a Just and Sustainable Energy Distribution by 2040
Judith Wright
James Conca

Amazon.com
YouTube.com
THERE ARE CARS ALL OVER THE WORLD STARVING FOR ETHANOL... SO FINISH YOUR CORN.
Access to energy is essential to quality of life. With modern efficiencies, conservation and technologies, 3,000 kWh/year can provide an HDI > 0.8; > 6,000 kWh/year is unnecessary and wasteful. Access to energy is essential to quality of life. With modern efficiencies, conservation and technologies, 3,000 kWh/year can provide an HDI > 0.8; > 6,000 kWh/year is unnecessary and wasteful.

80% of the world’s population of over 6 billion people is below 0.8 on the U.N. Human Development Index (HDI).

Source: United Nations Development Program; McFarlane 2006
How much energy do we need by 2040? - what levels are needed to end poverty, war and terrorism, i.e., raise everyone up to 0.8 HDI?

<table>
<thead>
<tr>
<th>Subpopulation group</th>
<th>Energy/capita needed to raise HDI to &gt;0.8 or maintain at 0.9</th>
<th>Approximate subpopulation</th>
<th>Annual energy requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrialized world - cut to</td>
<td>6,000 kWhrs/yr</td>
<td>1,000,000,000</td>
<td>6 tkW-hrs</td>
</tr>
<tr>
<td>Intermediate - maintain</td>
<td>3,000 kWhrs/yr</td>
<td>1,000,000,000</td>
<td>3 tkW-hrs</td>
</tr>
<tr>
<td>Developing world - increase to</td>
<td>3,000 kWhrs/yr</td>
<td>4,000,000,000</td>
<td>12 tkW-hrs</td>
</tr>
<tr>
<td>Those born by 2040 - achieve</td>
<td>3,000 kWhrs/yr</td>
<td>3,000,000,000</td>
<td>9 tkW-hrs</td>
</tr>
</tbody>
</table>

**Total Annual Global Energy Requirement 30 tkW-hrs**
The Target → a Third, a Third and a Third - 1/3 fossil fuel, 1/3 renewables and 1/3 nuclear

This requires renewables and nuclear worldwide to quadruple over what anyone is expecting by 2040:
a million 3+ MW wind turbines; over 1,700 new nuclear reactors; a 100 bbl of biofuels; 3 tkWhrs from solar; 3 tkWhrs from other
<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of Deaths in U.S. over the past 5 years*</th>
</tr>
</thead>
<tbody>
<tr>
<td>iatrogenic <em>(medicine gone wrong)</em></td>
<td>950,000</td>
</tr>
<tr>
<td>smoking</td>
<td>760,000</td>
</tr>
<tr>
<td>alcohol</td>
<td>500,000</td>
</tr>
<tr>
<td>automobile accidents</td>
<td>250,000</td>
</tr>
<tr>
<td>coal use <em>(~ 50% of U.S. power)</em></td>
<td>30,000</td>
</tr>
<tr>
<td>food poisoning</td>
<td>25,000</td>
</tr>
<tr>
<td>construction</td>
<td>5,000</td>
</tr>
<tr>
<td>hunting</td>
<td>4,100</td>
</tr>
<tr>
<td>police work</td>
<td>800</td>
</tr>
<tr>
<td>contraception</td>
<td>750</td>
</tr>
<tr>
<td>mining</td>
<td>359</td>
</tr>
<tr>
<td>nuclear industry <em>(~ 20% of U.S. power)</em></td>
<td>0</td>
</tr>
</tbody>
</table>
Even non-lethal routine accidents are dramatically lower in the nuclear industry than in any other industry.
Fourth, the Waste Isolation Pilot Plant has shown that deep geologic disposal of nuclear waste is safe and cost-effective.

The Salado salt formation take as much nuclear waste as we can generate in the next 10,000 yrs.
WIPP Salado Formation salt was deposited by repeated evaporation of shallow marine incursions into the Permian Basin of New Mexico.
At the 2000 lbs/inch$^2$ pressure at this depth, the salt exhibits significant creep closure, i.e., the salt completely closes all fractures and openings, even micropores, making the salt extremely tight, such that water cannot move even an inch in a billion years.
**10-Year Snapshot of WIPP 2009**

<table>
<thead>
<tr>
<th>Years of Operation</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loaded Waste Containers Disposed</td>
<td>100,000</td>
</tr>
<tr>
<td>Cubic Meters of TRU Waste Disposed</td>
<td>60,000</td>
</tr>
<tr>
<td>Fifty-five Gallon Drum Equivalents</td>
<td>300,000</td>
</tr>
<tr>
<td>Waste Panels Mined Out of 8 Planned</td>
<td>5</td>
</tr>
<tr>
<td>Million Miles Driven on Highways/Roads (Loaded)</td>
<td>7</td>
</tr>
<tr>
<td>DOE Sites Cleaned of Legacy TRU Waste</td>
<td>13</td>
</tr>
<tr>
<td>Releases to the Environment</td>
<td>0</td>
</tr>
<tr>
<td>Contaminated Personnel</td>
<td>0</td>
</tr>
<tr>
<td>Consecutive Years as NM Mine Operator of the Year</td>
<td>23</td>
</tr>
</tbody>
</table>

Sufficient capacity in the Salado for >10,000 years of nuclear waste disposal.

Source: DOE CBFO

Nuclear waste drums to WIPP, mostly contaminated debris.

Nuclear waste generated by defense activities.

Nuclear waste stored at many sites awaiting disposal at WIPP.