Piecing It All Together

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What Makes Us Do It?

- 10 CFR 20
  - Site Limits
  - Limits Instantaneous Offsite Concentrations
- 10 CFR 50, App I
  - Reactor Limits
  - Limits Dose to Member of Public from Effluents
- 40 CFR 190
  - Limits Dose to Member of Public from Uranium Fuel Cycle

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ODCM Needs Input From

- Meteorological Program
- Land Use Census
- Radiological Environmental Monitoring Program
- Radiological Effluent Controls

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ODCM

- Do I Understand My ODCM?
  - Can I perform the dose calcs?
  - Can I document every the source of every value used in the ODCM?
- Does the ODCM Implement the RECs?
- Compare the ODCM to the Guidance (NUREGs 1301 and 1302)
  - Do I Understand Why My ODCM is Different?
  - Can I Defend the Differences?

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ODCM Doses

- Most Restrictive Limits From App I
  - Stated in Terms of Organ Dose
    - Based On ICRP 2
  - Must Report Organ Dose
- Organ Dose is Not a TEDE
  - Total Effective Dose Equivalent –New Part 20
- Organ Dose is a Committed Dose
  - 50 Year Dose Commitment

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ODCM Dose Factors

- Four Primary Dose Exposure Mechanisms
  - Inhalation / Ingestion / Ground Plane / Immersion
- Taken From Reg Guide 1.109
  - Nuclides Not Found in 1.109 are Available Elsewhere (www.keysolutionsinc.com)
- Accurate Radionuclide ID Very Critical
  - Dose Factors Can Vary Between Nuclides by Over 12 Orders of Magnitude

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ODCM Dose Factors

- Dose Factors
  - Given for Seven Organs
  - Four Age Groups
    - Radio-Sensitivity and Consumption are Age Dependent
  - Include Dose Impact of Decay of Daughter Products
- Accurate Radionuclide ID Very Critical
  - Dose Factors Can Vary Between Nuclides by Over 12 Orders of Magnitude

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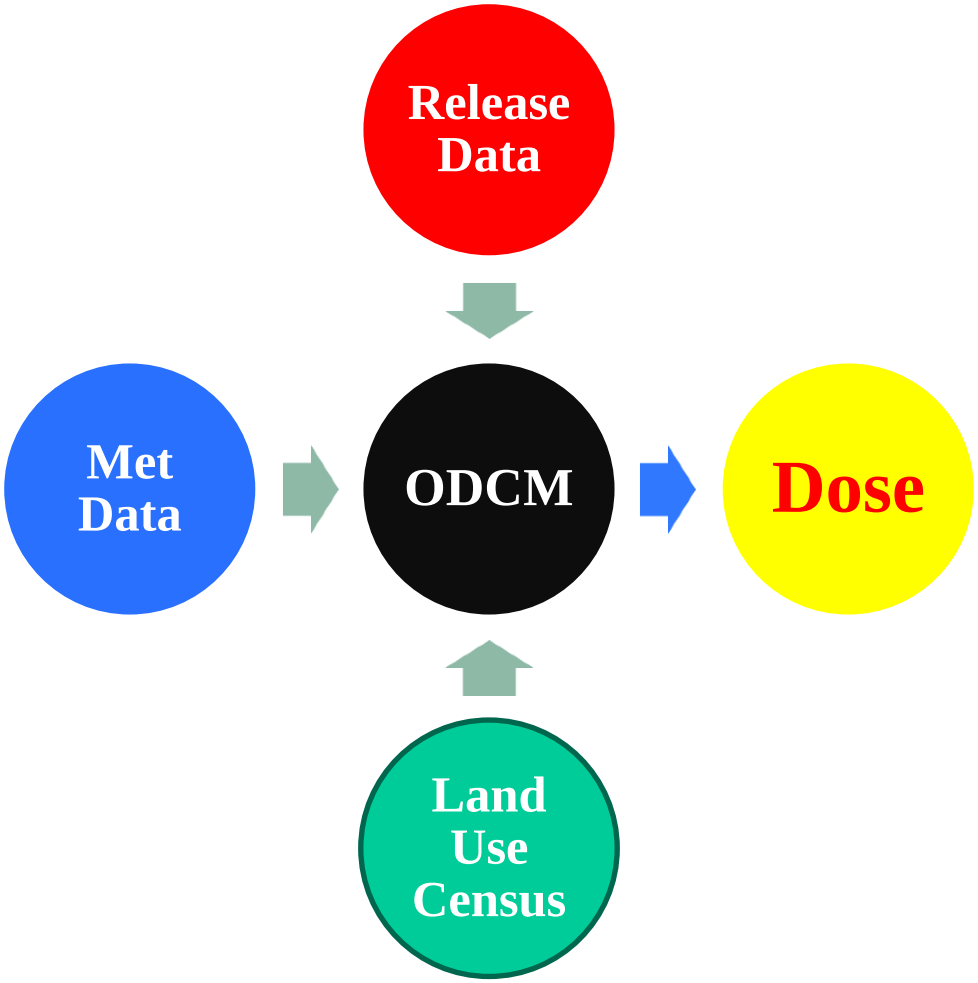
What Does the ODCM Do?



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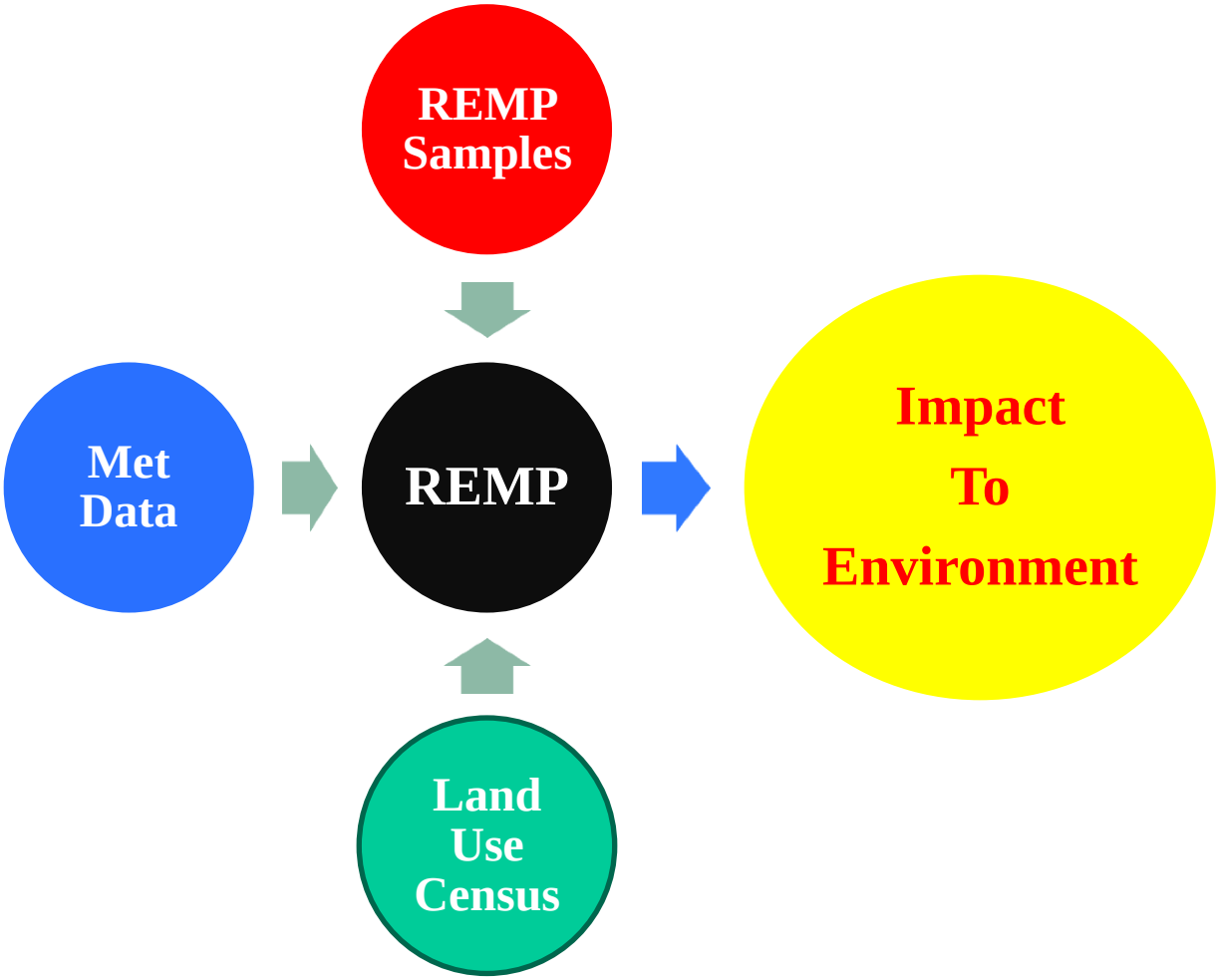
What Does the REMP Do?



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What Do We Have To Do?

- Limit Offsite Concentrations in Liquid and Gaseous Effluents
- Limit Dose to a Member of the Public (Real Individual)
- Monitor Environment to Identify Impact of Plant Operation
- Perform Land Use Census to Determine What Dose Pathways are Present

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Concentration Limits

- Instantaneous Limits
  - "the second is used as the practical reporting time unit for established release rates" [NUREG 0133]
- In effect at the location of highest offsite concentration.
  - Liquids – Site Boundary
  - Gases – Usually Site Boundary (not necessarily so for BWRs)
- No credit for dilution or decay in the environment.

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Dose Limits

- Three Sets of Limits
  - Liquid
  - Noble Gas
  - Radioiodine, Tritium and Particulates (RTP)
- Annual and Quarterly Limits
  - Must be determined in accordance with the methodology and parameters in the ODCM
  - Doses to be determined every 30 days.
    - Even if no discharges take place!!!

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Environmental Monitoring

- Radiological Environmental Monitoring Program (REMP)
  - Guidance found in Branch Technical Position (BTP) in NUREGs 1301 or 1302
  - Focuses on monitoring human exposure pathways.
- Defines an “acceptable minimum” Program
  - Thus Ensures a Minimum Environmental Effort

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Land Use Census

- From NUREG 0133:
  - "It is the intent … that a licensee undertake annual surveys of the age groups and the land use …"
- Purpose is to identify age group, location and exposure pathways with highest dose potential.

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How Do We Comply?

- Environmental concentrations can be below what can be directly measured.
- Dose limits so low that dose cannot be determined directly.
- ODCM Provides Means of Compliance:
  - Measurements
  - Set Points
  - Calculations

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Calculation of Virtual Dose

This is a No-No

- Dose Calculated Based on Non-Existing Pathways
- Overly Conservative Assumptions
  - All Dose Received at Site Boundary
  - Combining Various Existing Pathways into Single Receptor Location
- Sufficient to Demonstrate Compliance
- Does Not Provide an Accurate Dose Impact to the Public

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Multidisciplinary

- Physics
  - Health Physics
  - Nuclear Physics
  - Biophysics
- Mathematics
  - Data Analysis
    - Statistics: Parametric and Non-parametric
- Chemistry
  - Organic / Inorganic
  - Radiochemistry
- Biology
  - Agriculture
  - Botany / Zoology
  - Radioecology
    - Ecosystem Modeling
  - Physiology
- Earth Sciences
  - Atmospheric Sciences
  - Hydrology
  - Physical Geography
  - Soil Science

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Insufficient Resources

- Expertise Being Lost
  - Regulators
  - Licensee
- Reduction in Staffing
  - Regulator
  - Licensee
    - Seeing High Personnel Turnover
- Reduction in Funding
  - Regulator
  - Licensee

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Training and Turnover

- Not Many at Site Will Understand ODCM and REMP
- 1 - 2 Years Experience To Learn Routine
- 5 – 7 Years Experience To Keep Site Out of Trouble
- 7 + Years To Deal With Issues Way Outside of ODCM Space

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Key Solutions

What's Wrong With This Data?

Year	Average at Farm	Average at Residence	Control	Year	Average at Farm	Average at Residence	Control
< 1984	113.1	123.9	148.9	1997	72.8	83.8	104.5
1984	79.4	83.8	110.3	1998	71.7	80.8	118
1985	116.9	121.5	156.6	1999	74.5	82.5	104
1986	104.2	106	150.9	2000	76.2	84.5	105.6
1987	84.3	88.8	104.3	2001	73.6	82.4	102.2
1988	72.3	78.6	112.6	2002	76.6	85.3	108
1989	63.7	61.7	89.4	2003	77.4	86.6	108.8
1990	52.2	50.7	70.1	2004	80.1	87.5	110.4
1991	61.2	65	88	2005	79.3	89	104.7
1992	76.2	73.2	92	2006	82	90.2	108.8
1993	74.8	80.6	93	2007	81	90	108
1994	86.8	94.7	112	2008	84.6	95	111
1995	93.6	101.7	132	2009	83.7	93	110
1996	68.5	78.3	101				

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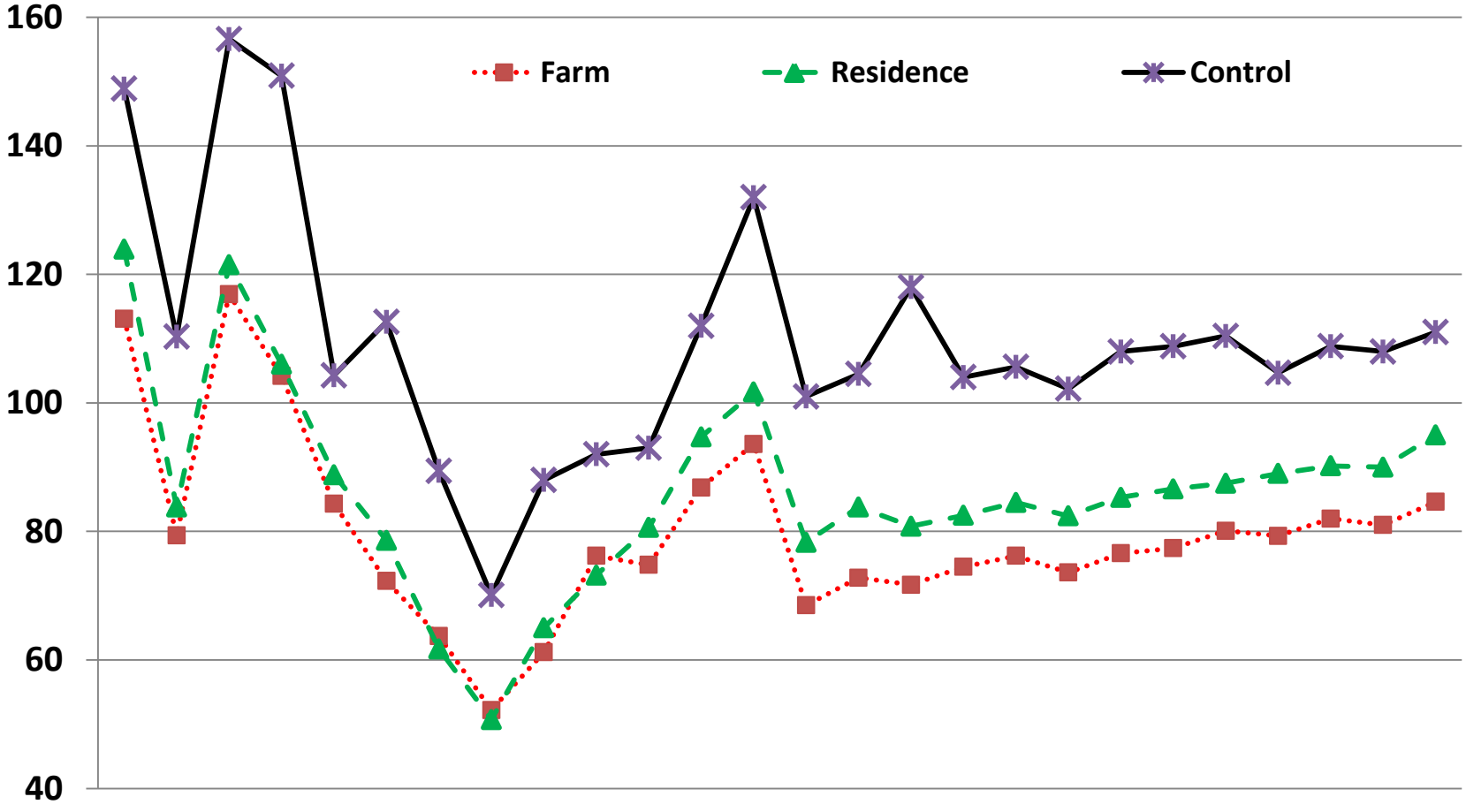
Control Higher Than Indicator!?!



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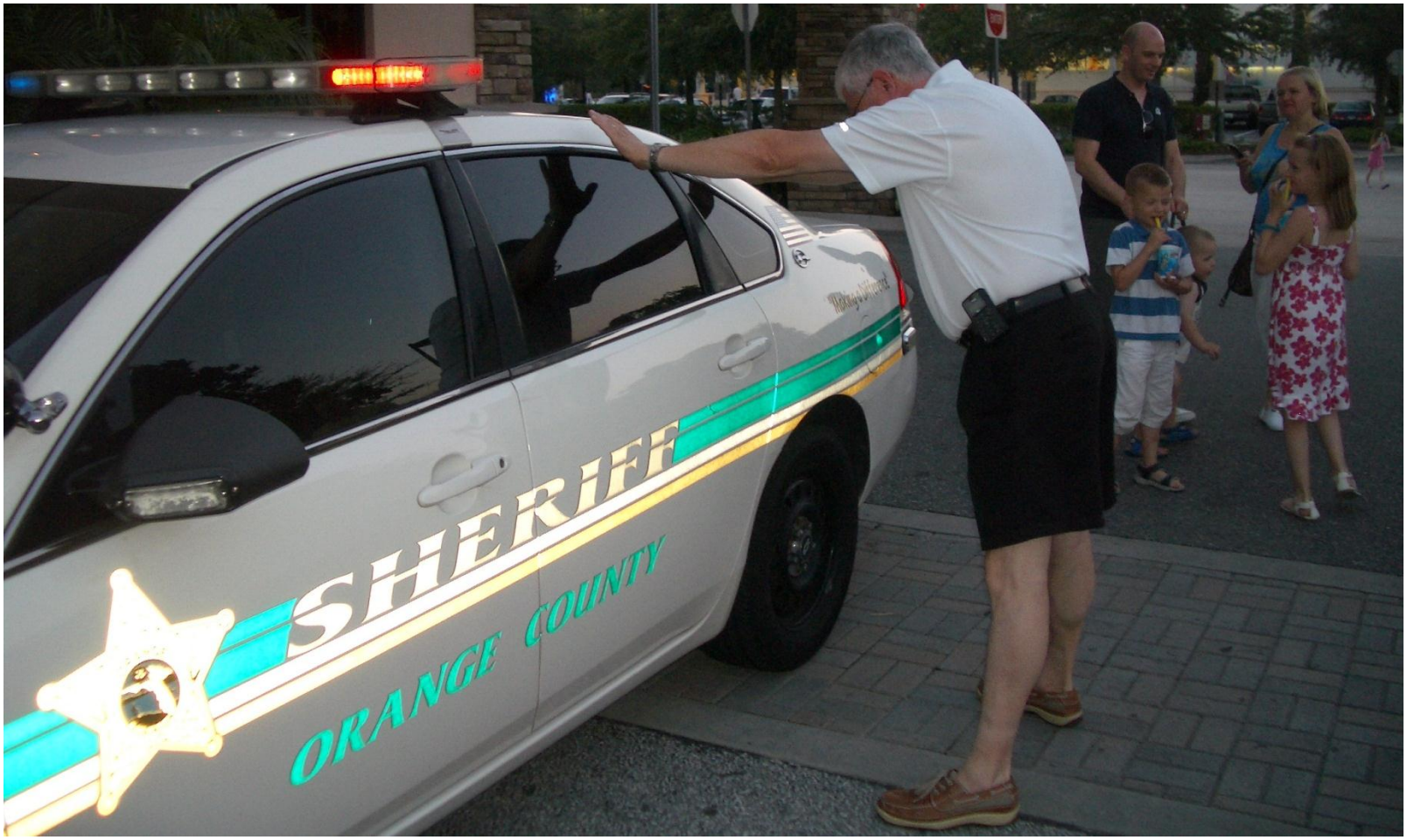
Busted - REMP Arrest!!



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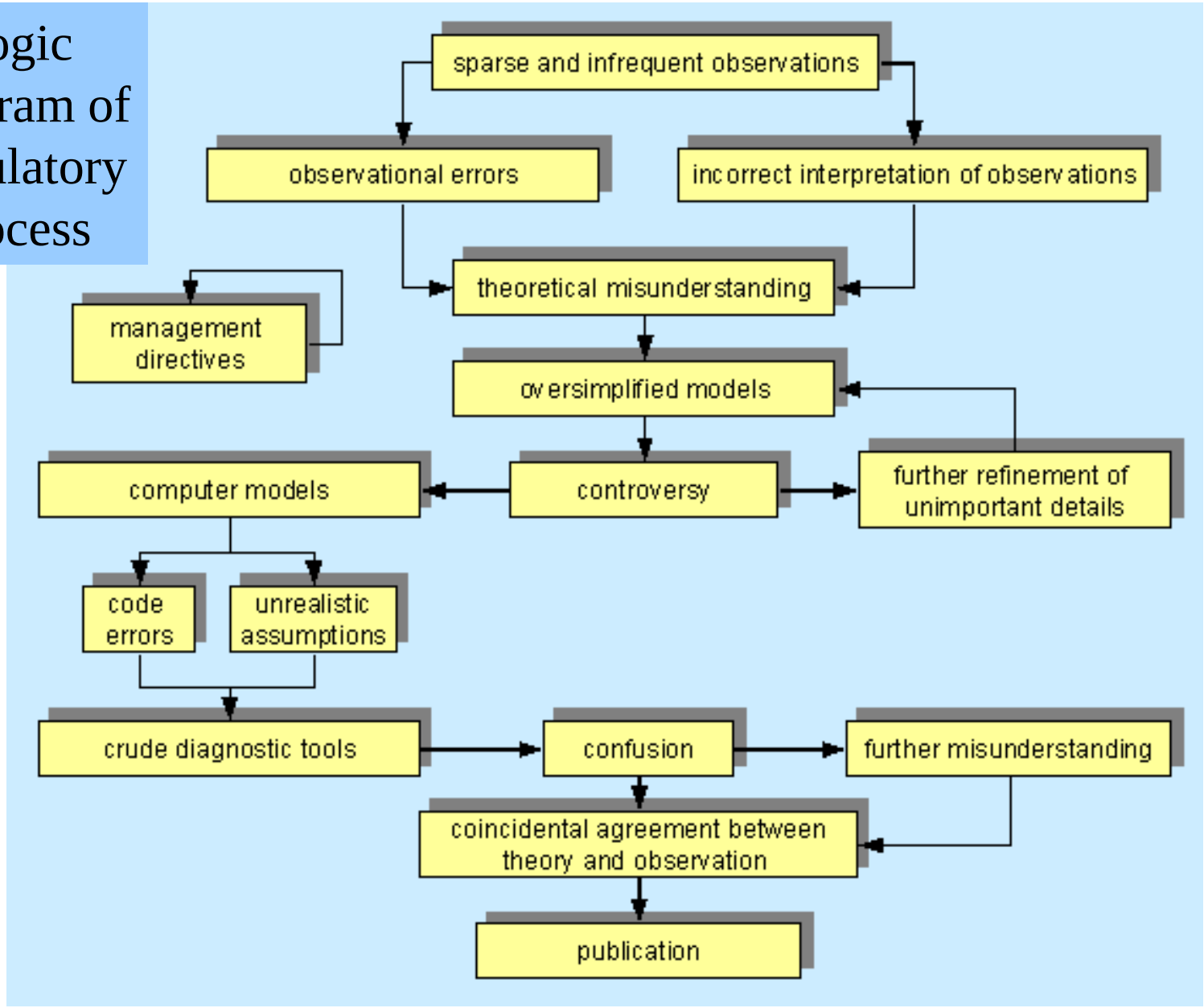
Logic Diagram of Regulatory Process



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Stuff You Need to Know

- Documents You Need Now
  - Reg Guide 1.21, Rev 1
  - Reg Guide 1.109
  - NUREG 0133
  - NUREG 1301 (PWR) or 1302 (BWR)
- You Will Need to Educate Inspectors and Auditors
- Be Aware There are Conflicts in Guidance Docs
- Your Site May Have Commitments to the State That Go Beyond the NRC Requirements
  - Check This Out!!

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This Is Fun Stuff!!

Always On The Learning Curve So…Keep Studying!!

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Reflections

- ODCM and REMP Must Work Closely Together
  - Opinion: ODCM Best Under Chemistry
- Easy For a Site or a Utility to Get Tunnel Vision
  - This is a quick recipe for trouble.
- Just About Time I Think I've Seen It All I'm Wrong
  - Lots of Differences in the Industry
    - Different is OK – Just understand why.
    - Be prepared to defend why.

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Some of My Favorite Audit Issues

- Who owns the ODCM / REMP / Rad Monitors?
- Can you defend the methodology and parameters in the ODCM?
- Can you prove you met the LLD for all nuclides in this release?
- Are your setpoint calculations correct?
- Any unplanned / unmonitored releases?
  - Can you defend the dose assessment?
- And many, MANY more.

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Advice for New REMP/ODCM People

- RETS-REMP Workshop is Very Important
  - Tries To Stay One Step Ahead of the Issues.
  - You Need To Network – This is the best place.
  - Never Know Who You'll Meet

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Advice for New REMP/ODCM People

- If you are confused it means you are paying attention.
- Never Assume Anything
- Be Very Paranoid
- Know Who Your Radiological Neighbors Are
  - Many Industrial and Medical Users Out There
  - Can Result in Nasty REMP Surprises

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Key Solutions

Get a Head Start on the Annual Reports

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Be Flexible and Think Outside the Box

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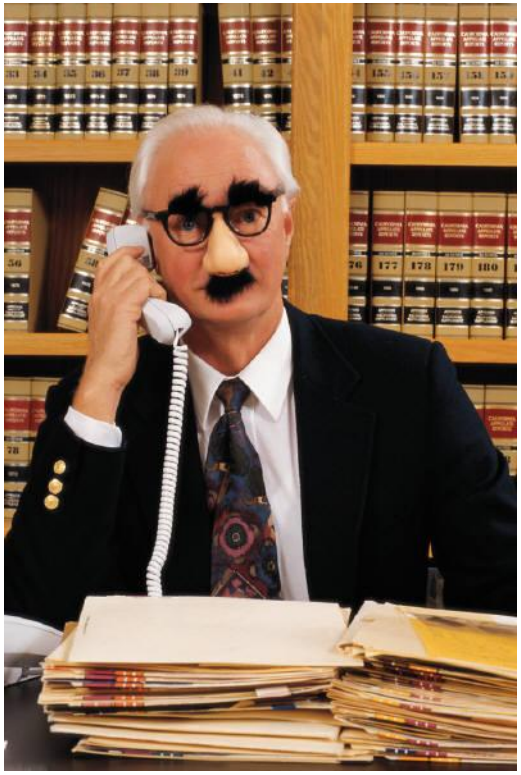
New People – Never Forget

- You are not alone…
- Pickup The Phone
- The old REMP/ODCM soldiers have fought a lot of battles.



The Original Chart of the Nuclides	
Air	**Earth**
Fire	**Water**

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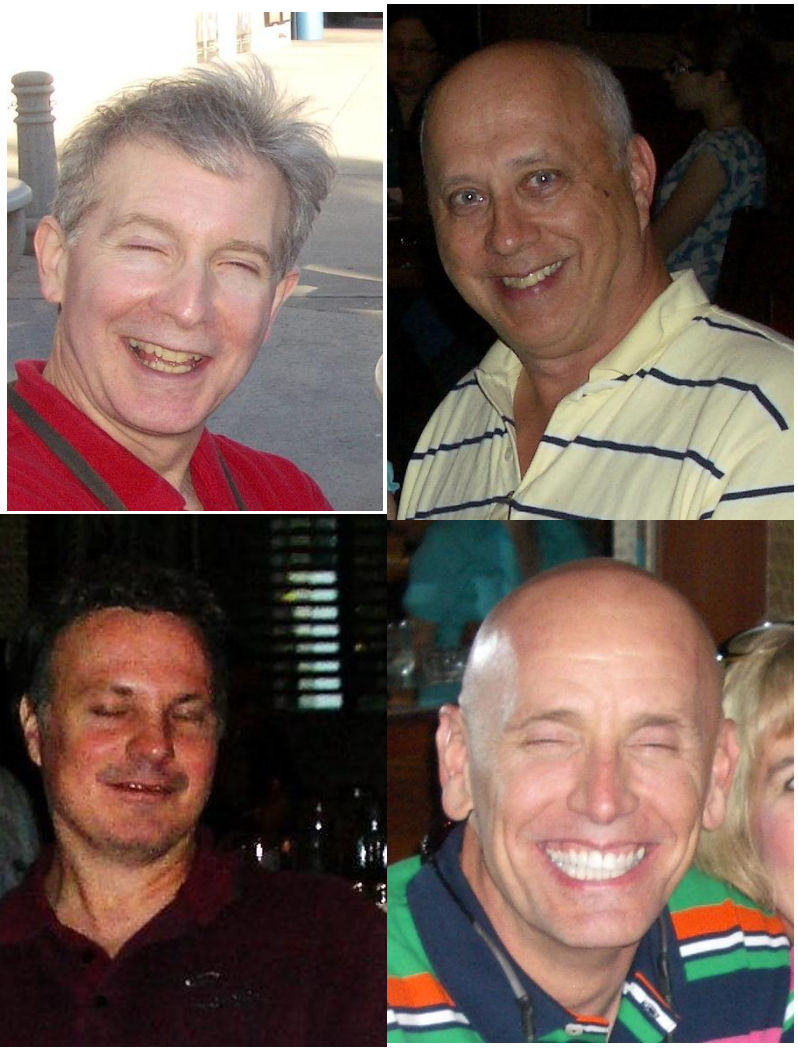
Health Issues Associated With REMP/ODCM

- Vision Impairment
- Fatigue
- Baldness



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Examples of *Acute ODCM Syndrome*

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- *Atmospheric Science and Power Production*. Randerson, 1984 (this is update to Slade)
- *Workbook of Atmospheric Dispersion Estimates*. Turner, 1970
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- *Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Terrestrial and Freshwater Environments*. IAEA Special Reports Series No. 472
- *Radiological Assessment: Predicting the Transport, Bioaccumulation, and Uptake by Man of Radionuclides Released to the Environment*. NCRP Report No. 76.

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- *Age-Specific Radiation Dose Commitment Factors for a One-Year Chronic Intake*. NUREG 0172
- Methods for Demonstrating LWR Compliance With the EPA Uranium Fuel Cycle Standard NUREG 0543
- *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations*. NUREG 2919
- *Radiological Assessment, A Text Book on Environmental Dose Analysis*. NUREG/CR 3332

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References and Resources – NRC Reg Guides

- *Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Release of Radioactive Materials in Liquid and Gaseous Effluents From Light-Water-Cooled Nuclear Power Plants*. Reg Guide 1.21, (rev 1 for ORs rev 2 for New)
- *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix*. Reg Guide 1.109
- *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases From Light-Water-Cooled Reactors*. Reg Guide 1.111

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  - www.nrc.gov/reading-rm/doc-collections/nuregs/
- DOE Information Bridge
  - www.osti.gov/bridge/
- DOE Radiation Safety Information Computation Center (RSICC)
  - https://rsicc.ornl.gov/Default.aspx
- RETS-REMP Workshop
  - www.rets-remp.org
- Key Solutions
  - www.keysolutionsinc.com
  - Most Reg Guides and NUREGs

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References and Resources – Misc

- Computer Codes
  - RSICC
    - LADTAP
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    - XOQDOQ
    - RABFIN
    - NRCDOSE
  - NRC Radiological Toolbox
    - www.nrc.gov/about-nrc/regulatory/research/radiological-toolbox.html
- Dose Factors
  - ICRP 2 dose factors, etc. not found in Reg Guide 1.109
    - www.keysolutionsinc.com
  - ICRP 72 Dose Factors published in FGR 11, 12, and 13
    - www.rets-remp.org

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