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FIATECH

3D Radiation Exposure Modeling Tool for ALARA Planning: Kewaunee Pilot

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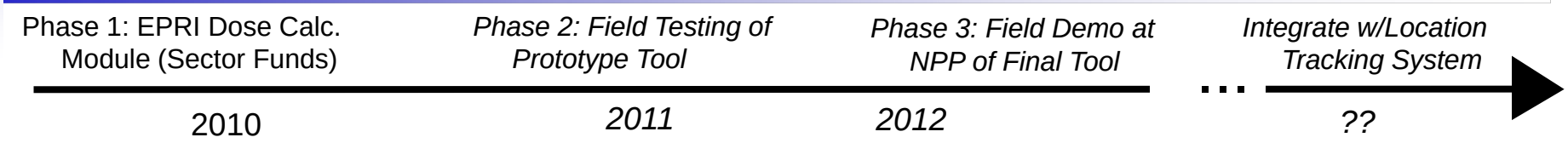
RP 2020 Technology Development: 3D EDE ALARA Planning Tool (in collaboration with FIATECH)



Objective:

- Work with FIATECH and 3D Technology Providers to develop a prototype for the **next generation** ALARA and work planning tool.

Description:

- Leverage and adapt advanced 3D technologies from other industries to **enhance work planning** and provide more **accurate dose estimation**.
- Future: Integrate with remote monitoring systems for **dynamic monitoring** of work activities.

Benefits:

- Optimize work activities and work flow
- Develop “What-if” scenarios to identify radiation field reduction opportunities to further reduce worker dose and document options.

Schedule:

- 3 year project, started in 2010 (2010 scope funded by Nuclear Sector)

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ALARA Planning- Outline

Ideal: Maintenance Planning = ALARA Planning

- Prepare work plan, understand tooling, number of workers, duration, locations, etc.
- Radiation Sources
- Estimate dose received by workers
- Evaluate possible efficiency and dose reduction methods

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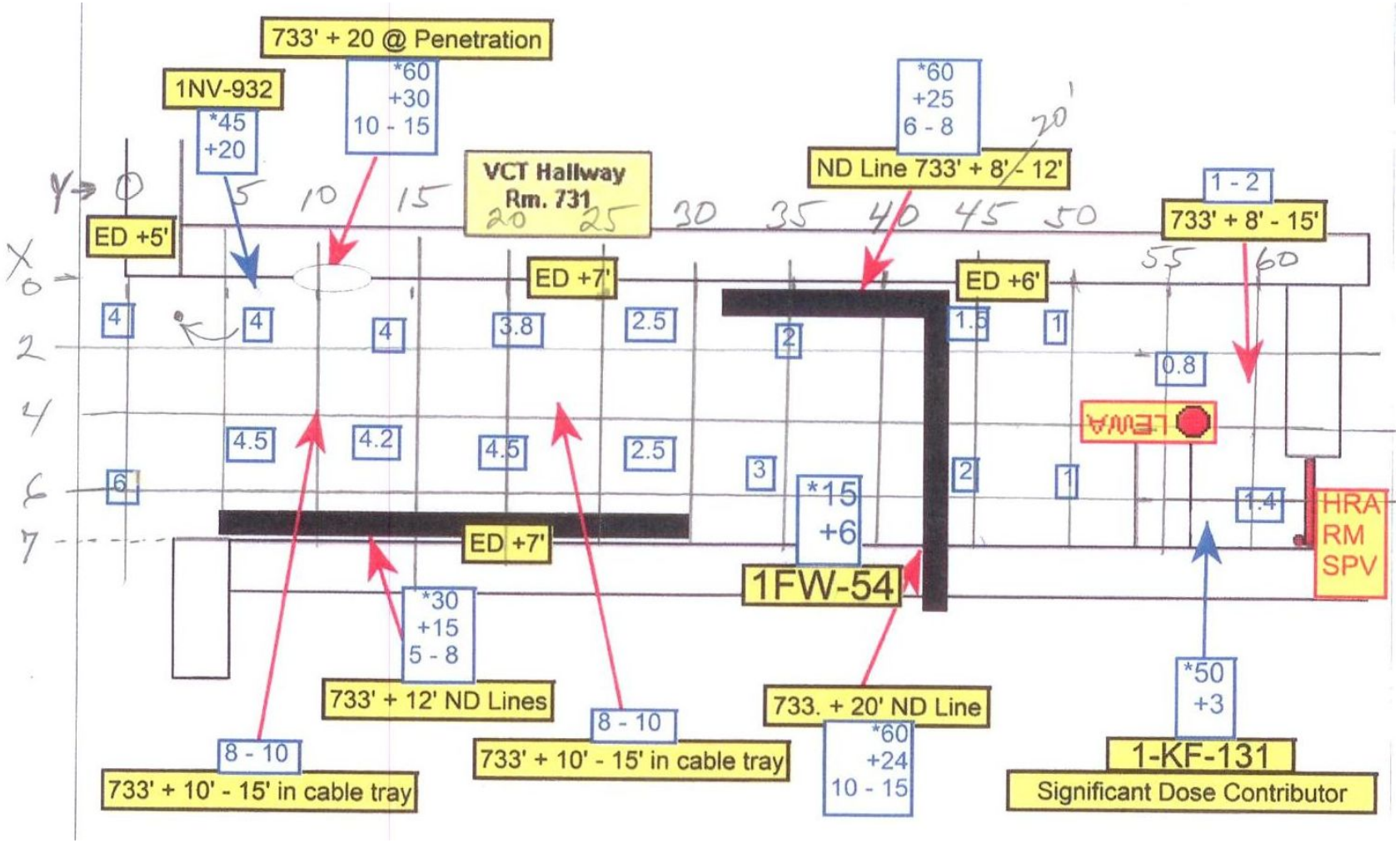
Typical Dose Estimating Methodology

- Maintenance Planning provides info on man-loading
  - 2 people, 5 days (8 hr/day)
  - Total time = 80 man-hr

- ALARA Planner
  - Takes total time (80 man-hr) and applies a reduction factor such as ¼ to give ~ 20 hours to estimate time on location.
  - Takes the adjusted time and uses an estimated dose rate (assume 30 mrem/hr x 20 hr = 600 mrem)

Plant B Radiological Survey Map



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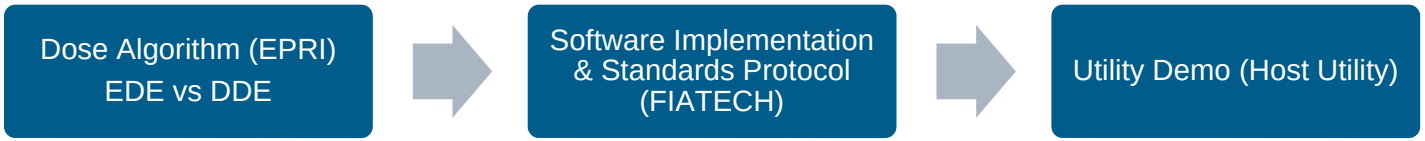
Goals for Project

- Project Goals:
  1. Provide a more rigorous methodology and process for estimating the dose rate for a worker at a location based on routine survey/radiation field measurements
  2. Estimate worker dose or EDE based on ALARA, “what-if” optimization scenarios.
  3. Work with FIATECH and vendors to develop standard software implementation protocols that encourages “plug and play”



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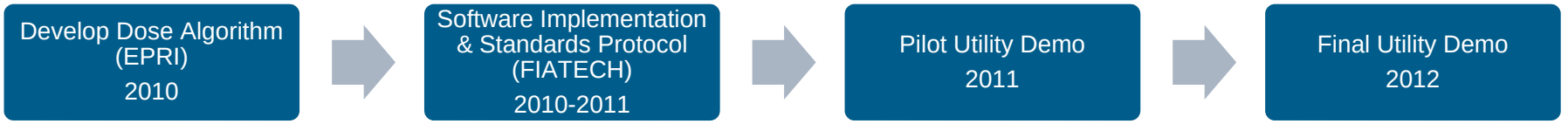
Tentative Project Schedule



- **2010-2011**
  - **Review and develop dose algorithms**
  - **Internal algorithm validation and lab testing**
  - **Provide dose calculation subroutines to FIATECH/vendor(s)**
  - **Vendors to begin development of a prototype for pilot test**
  - **Work with host utility and their vendor to plan plant demo**
  - **Perform demo and analyze results**

2012

- **Larger demo with final prototype**
- **Document final demonstration (EPRI Technical Report and software executable- publicly available)**

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Organization Responsibilities

FIATECH

- Oversee and coordinate solution providers (vendors)
- Provide technical input
- Develop user specs
- Demonstrate software to validate dose algorithm
- Produce final deliverable

EPRI

- Develop dose algorithm
- Establish project schedule
- Provide user input for specs
- Select utility to host demo site for Case Study
- Prepare final report

Vendor responsibilities

Participants:

Bentley Systems, CSA, Dassault Systemes, Siemens

- Willingness to collaborate with other vendors to develop tool
- Interaction with host site personnel and users to develop specs for development of the tool
- Participation in Team Meetings, both virtual and on-site
- Provision of on-site technical support for demonstration
- Resolution of post-demonstration issues prior to completion of final deliverable
- Hand over of final prototype deliverable

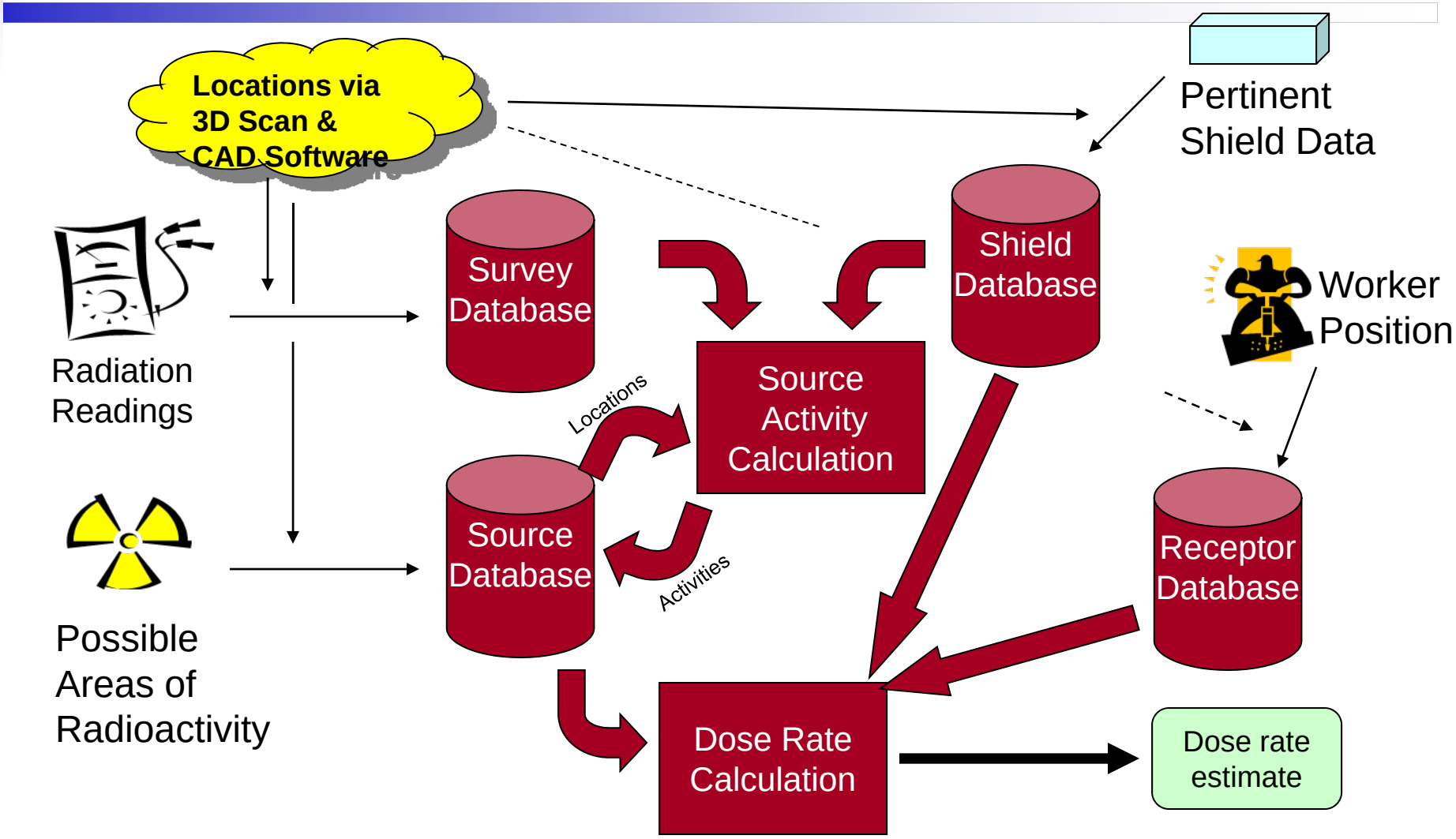
EPRI Dose Rate Algorithm- Basic Description

Method utilizes the 3-dimensional locations of radiation survey readings, shield information, possible source locations, and worker position(s) --- Development Lead: Ted Rahon, PhD, CHP

- Localization of these objects is facilitated by 3rd-party laser scanning systems and software.
- User inputs: 1) radiation survey data and 2) possible positions of accumulated radioactivity (i.e., “sources”) based on technicians’ knowledge of the “hotspots” in the area or room.

- Estimated amount of radioactivity (iterative regression analysis). From these radioactivity estimates, the resultant radiation field is then calculated at the worker position. Goodness-of-fit parameters are then used to estimate the uncertainty of the final dose rate estimate at the worker location.

Dose Estimation Algorithm Flow Chart



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EPRI Dose Algorithm: Preliminary Laboratory-Based Test Results

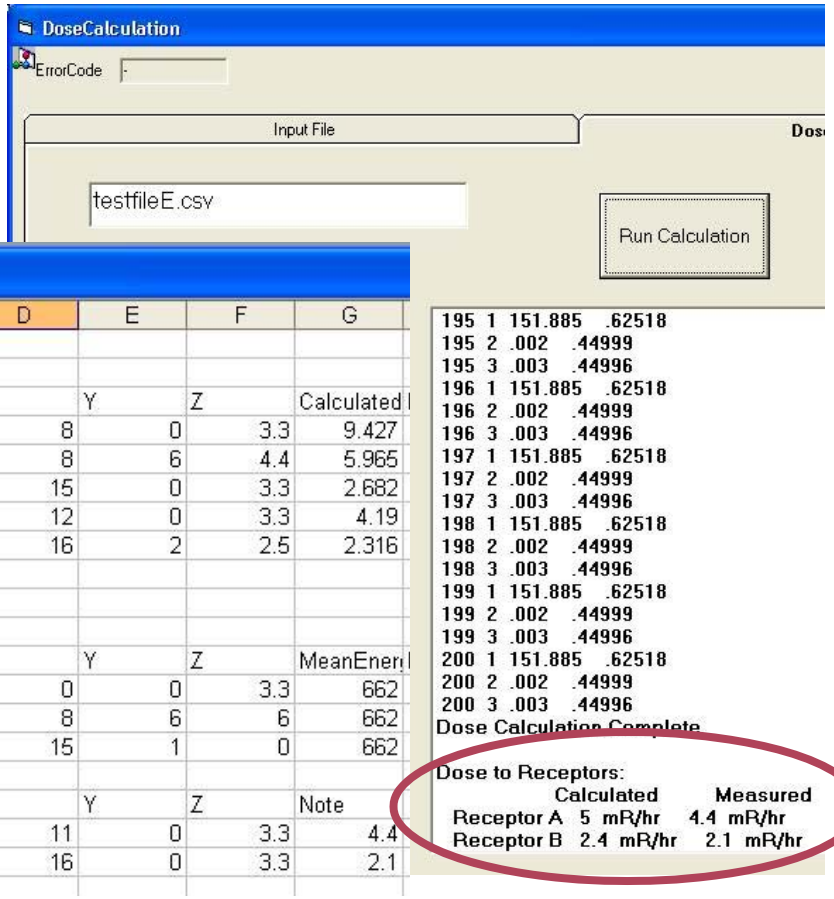
Input (Vendor):

- Dose rate survey measurements (x, y, z)
- User identified potential sources, mean energy, shielding
- Worker location (x, y, z)

EPRI Dose Algorithm

Output (Vendor):

- Estimated source activity
- Estimated Dose Rate at a non-measured location



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Host Site Selection

- 2011: pilot, 2012: full scale maybe different sites and/or different reactors

Site Requirements:

- Laser scanned room or 3D model of room
  - Required for visualization aspect of project
  - Required for accurate dimensioning of sources and shields
  - Supports accurate x,y,z for survey data
- Accurate radiological survey data
- Accurate survey maps (**drawn to scale**)
- Pre-demonstration site visit
- Site access for team
- Approval by management

Pilot Test at Kewaunee

- Pilot Test
  - Select a model task
  - Perform surveys, as needed
  - Perform “typical” ALARA planning for task (engage maintenance, ALARA Planners, etc in process)
  - Perform ALARA planning using beta version of prototype (engage maintenance, ALARA Planners, etc)
  - Perform task
  - Compare estimates to actuals
  - Interview participants to understand their level of “confidence” with each type of ALARA planning methodology