

**ROUTE CHARACTERIZATION AND ASSESSMENT IN A PROSPECTIVE  
NATIONAL CAMPAIGN FOR CROSS-COUNTRY TRANSPORT OF SPENT  
NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE:**

**THE POTENTIAL APPLICATION OF AN EMERGING TOOL  
(FIRST PHASE EVALUATION)**

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## Introduction

With support from Black Mountain Research and GeoDecisions, the Western Interstate Energy Board (WIEB) is conducting a pilot test of a web-based geospatial portal (IRRIS) for characterization and assessment of potential routes for spent nuclear fuel transport, and for assessing state-local emergency response capabilities and needs. Many have called for route assessments that are detailed, “featured,” updatable, and packaged for effective use by state and local agencies in emergency response planning, assessing emergency response training and equipment needs, and evaluating routing options.

Despite the calls, such information has been produced only ad hoc, and for limited segments of selected routes. The major, very practical reason is that, using standard tools and procedures, the development and maintenance of such information over thousands of miles of rail and highway routes crossing many states and local jurisdictions are daunting tasks—far exceeding current state agency resources or prospective federal funds. Even if such information were available, there is no capability for distributing it in useful formats to those that have specific responsibilities along specific segments of a regional or national system.

Emerging tools offer the prospect of much more efficient and consistent assembly and maintenance of such information, and much more flexible, task-relevant distribution to those with particular responsibilities along particular route segments. The WIEB pilot inquiry evaluates the application of an emerging GIS-based tool (IRRIS) for these purposes, focusing in this first phase on current guidelines for route comparison. If states and other stakeholders conclude that the results are promising, steps toward fuller development and distribution will be considered. The initial pilot phase will extend over the next six months<sup>1</sup>.

This report addresses two broad topics:

Sections 1-3 consider the utility of IRRIS (by GeoDecisions) as the basis for this pilot inquiry.

- Section 1 considers the range of potential uses for detailed, “featured” information in spent nuclear fuel (SNF) transportation planning and operations.
- Section 2 reviews some of the calls for detailed, featured route information, and speculates on the reasons for the limited response to such calls to date.
- Section 3 presents the rationale for the choice of IRRIS as the basis for the pilot inquiry, and (looking ahead) considers the institutional challenges in effective application of integrated information systems by myriad federal, state, local, and private agencies.

Sections 4 and 5 consider the steps needed to make IRRIS useful—the steps needed to provide a basis for decisions whether and how to move forward, now or later. The focus in this phase is the current IRRIS system, and the broad set of SNF route characterization and assessment purposes.

- Section 4 reviews the current IRRIS resource and capabilities as described by its creators at GeoDecisions. Based on the review,
- Section 5 identifies several lines of inquiry for the first phase pilot test.
- Background and reference information is included in several appendixes.

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<sup>1</sup> Dependent on DOE/OCRWM funding of the WIEB FY’09 Cooperative Agreement.

## 1.0 The Uses and Purposes of Detailed, “Featured” Information

Why is detailed, “featured” information needed in route characterization and assessment for large-scale cross-country transport of spent nuclear fuel (SNF) and high-level radioactive waste (HLRW)? Many tasks in planning and operating a national shipment campaign require detailed, “featured” information about route conditions and their environments, distributed in forms directly relevant to those with various roles and responsibilities. Here is a list of the most obvious:

- 1.1 **Assessment of route-specific shipment hazards.** Route-specific hazards are attributes of the route itself or of its environs that increase the *likelihood* of an accident or incident, or that increase the *consequence* of an accident or incident should such occur.

Currently, state officials responsible for conducting such assessments in, for example, Tennessee, Illinois, Texas or Wyoming are likely to have access different types of available information, of widely varying currency and quality. Some would propose additional data collection and/or verification before assessments. Assessments would start from different bases, leading to inconsistent and confusing conclusions.

- 1.2 **Assessment of measures needed to avoid or mitigate route-specific hazards.** These might involve infrastructure improvements, regulatory measures, or operational controls, which may be implemented by carriers in coordination with state/local governments, or by state/local governments in coordination with carriers.

Currently, hazard avoidance processes are haphazard. Carriers (rail and truck) operate in different states with different regulatory approaches. Varying mitigation measures (and funding options) are likely in response to similar hazards. Whether measures are appropriate (and, perhaps, worthy of funding) is difficult to assess, because different parties use different information sources and different collection/validation/update procedures, and because some aspects (particularly vis-à-vis railroads) may be held confidential.

- 1.3 **Assessment of state-local emergency response capabilities,** in the event of an accident or incident along a particular segment of a prospective route.

Currently, DOE’s Transportation Emergency Preparedness Program (TEPP) has model needs assessment guides<sup>2</sup> for emergency management planning, emergency communications centers, hazardous materials teams, fire response organizations, law enforcement organizations, and emergency medical services and care facilities. However, while many entities have used the guides, many have not. Those that have used the guides may not have updated them, or applied the results to assess and upgrade capabilities.

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<sup>2</sup> TEPP Planning Products: Model Needs Assessment, Self-Assessment Document. DOE Office of Transportation and Emergency Management, REV 5-04/2005. See Appendix E.

- 1.4 Development of state-local emergency response plans:** how best to apply current capabilities (adequate or inadequate) in response to various types of accidents, incidents or contingencies that could occur along different segments of cross-country shipment routes.

Even if adequately documented, local response capabilities will continue to vary widely along thousands of miles of cross-country transportation routes. How to deploy current capabilities in particular instances will continue to rely on the judgment of ER professionals, working (presumably) in coordination. However, if all parties had access to similar types of information (with similar levels of reliability), the range of uncertainties could be reduced, and judgments could be more focused and more confidently and consistently applied.

- 1.5 Shipment operations management<sup>3</sup>.** Shipments of SNF will be conducted in complex and constantly changing environments. Contingencies include traffic conditions, mechanical problems, weather, local events, non-SNF accidents and incidents, and security-relevant observations by escorts or others. This information is needed in making judgments during shipment operations—e.g. whether to use safe parking or safe havens.

Currently, carriers are primarily responsible for monitoring such conditions, and for making the appropriate judgments. Regarding SNF shipments, state and local agencies may have greater responsibility to provide the relevant information, along with greater interest in being consulted regarding operational decisions. Information systems, applicable in both urban and rural areas, will be needed to support the operations management process.

- 1.6 Real-time deployment of available resources in response to accidents or incidents.** Rapidly delivered map-referenced information regarding relevant conditions, capabilities and capabilities at specific accident locations can help local responders be more effective, and more effectively coordinated with other parties at interest.

Major metropolitan emergency response organizations (e.g. Allegheny County, PA) have developed GIS resources for more effective emergency response. However, similar capabilities are not available along the thousands of miles of prospective SNF shipment routes. Major railroads (e.g. CSX) have developed GIS resources for similar purposes, but their information is generally proprietary—not to be shared with state and local agencies.

- 1.7 Solicitation of local input and building local acceptance** through review of prospective shipment campaigns and consultation with states, localities and other stakeholders.

Local acceptance of a proposed campaign for spent fuel shipment, and local confidence in the parties responsible will not be easily achieved. But such acceptance and confidence almost certainly cannot be achieved unless responsible officials can present

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<sup>3</sup> Shipment operations could also include monitoring, tracking, and notification applications.

(in a readily accessible form) information on relevant local route conditions and characteristics. Presentations that inexplicably omit the local school or nursing home, the bridge in poor condition, or a high accident location may be doomed from the outset. Presentations that clearly do recognize local conditions can provide the basis for constructive discussion.

To date, such discussions have been possible mainly in “affected communities” that have used nuclear waste funds to collect information for presentation in maps and reports. However, the prospective campaign is national in scope, involving thousands of miles of prospective rail and highway routes, affecting hundreds of localities, urban, suburban and rural. Will DOE/OLM itself conduct this level of community review? Will DOE ask affected states to conduct the review, perhaps using Section 180(c) “planning grants”? Either way, reliable and detailed route-specific information in readily accessible formats (plus information on the proposed shipment campaign) will be a necessary basis.

**1.8 Assessment of intermodal shipment options.** Though the National Academy of Sciences strongly recommends the use of dedicated trains for cross-country shipment,<sup>4</sup> and though DOE’s current proposed action contemplates dedicated train shipment,<sup>5</sup> many shipment origins lack Class A rail access, thus requiring intermodal shipment (heavy-haul truck, shortline rail, barge) to access a railhead for cross-country shipment. The process to solicit local input and build local confidence in intermodal shipment options is a special case of the cross-country process discussed in Section 1.7 above.

Currently, the Federal Railroad Administration (FRA) is assessing shortline railroads serving nuclear facilities, beginning with the Winchester and Western Railroad that serves the Salem and Hope Creek plants in New Jersey. The FRA’s focus, however, is the rail line itself, not its environs.<sup>6</sup> Also, information needed to assess heavy-haul options (to the same of different rail heads) is not part of the FRA process. Local confidence in intermodal shipment choices will be difficult enough to achieve, even with reliable information on all relevant route selection considerations.

**1.9 Route selection.** DOT guidelines<sup>7</sup> suggest several comparison factors for selection of preferred highway routes for SNF shipments. Primary factors are: 1) Normal radiation exposure; 2) Public health risks from accidents; and 3) Economic risks from accidents. Secondary factors include: 4) Emergency response capability; 5) Evacuation options; 6) Location of special facilities, such as stadiums, schools and hospitals; and 7) Traffic

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<sup>4</sup> “Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level radioactive Waste in the United States,” National Research Council, Committee on Transportation of Radioactive Waste (2006), Section S.4, pg. 16.

<sup>5</sup> “Draft Supplemental EIS for a Geologic Repository....” DOE/OCRWM, DOE/EIS-0250F-S1D (October, 2007), Table G-10.

<sup>6</sup> Also, procedures for documenting and sharing (e.g. using GIS) the information collected have not been developed.

<sup>7</sup> “Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantity Shipments of Radioactive Materials,” U.S. Dept. of Transportation, Research and Special Programs Administration; DOR/RSPA/HMS/92-02, August 1992. See Appendixes B and C.

fatalities and injuries. The Federal Railroad Administration has not established such factors for railroads,<sup>8</sup> but recent rule-making<sup>9</sup> requires railroads to identify risk factors in rail transport of hazardous materials and to consider these factors in shipment routing.

Currently, the models used in route selection (e.g. RADTRAN) focus on the DOT's primary factors only, and these using abstracted information (e.g. census population data, averaged to estimate the number of potential human receptors within 800 meters of a prospective route) rather than "featured" information on schools, hospitals, refineries, bridge conditions, etc. The result is an abstracted measure of radiation and risk—a measure that can be convincing to model creators and users, and accepted by DOE managers who seek a technically impartial basis for route selection.

In our pluralist, federal system, actual route selection for SNF transport may be more complicated:

- Abstracted measures generated by RADTRAN are unlikely to be convincing in affected local communities;
- Societal risks (however expressed) are likely to be as or more salient than radiological or accident risks;
- Best practice transportation plans (acceptance queue, mode, cask testing, operational practices and monitoring) are likely to be the first consideration: "Assure us that you are doing this right; then we can discuss routes."
- State-local awareness, preparedness, and involvement may trump moderate differences in estimated radiological or accident risk.

Detailed, featured, reliable information on both the primary and secondary factors (this produced in consistent fashion for thousands of miles of prospective routes) will be needed—first in route selection, then in route comparison and acceptance.

**1.10 Route comparison.** Understandably, carriers want the freedom to use any route that meets RADTRAN-like technical criteria. State-local constituencies, on the other hand, are more likely to accept shipments conducted in best practice along routes for which they are (by their own judgment) prepared. If best practice involves, say, concentrated efforts to clear shutdown reactor sites, acceptance is likely if affected states and localities believe they are prepared to meet their responsibilities and to address contingencies.

The current Section 180(c) program (intended to fund training for first responders along DOE-selected SNF transportation routes) may not meet the above standard. As mentioned, route selection will require more elaborate and informed consultation than RADTRAN-based criteria imply. Also, preparedness involves the judgment of state-local emergency planners and responders—after they understand and accept: a) the best practice campaign, and b) their own capabilities to address contingencies.

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<sup>8</sup> In contrast to public highways, railroad rights-of-way, track and switching facilities are privately owned and operated; railroads have detailed procedures for switching cross-country shipments from one carrier to another.

<sup>9</sup> PHMSA, HM132E. See Appendix D.

**1.11 Enhancing federal-state cooperation** in all aspects of transportation planning and operation. It's obvious that federal-state-local coordination and cooperation is a major challenge in a national campaign for cross-country SNF shipment. The federal government is responsible for the selection of modes, sequence, equipment, operational practices, and routes. It has "commerce clause" and "common carrier" authorities to "make shipments happen." At the same time, in a federal system of government, states have their own regulatory authorities, and primary responsibility for public safety, and therefore for first response and accident management. Further, being closer to affected communities, states may be more attentive to the societal risk component of SNF transportation, which was highlighted by the National Academy of Sciences in its 2006 report.<sup>10</sup>

Of course, in and of itself, information cannot produce the consultation, coordination, and cooperation needed to ensure safe, secure, and uneventful cross-country transport of SNF. However, better and more relevant information can provide the basis for effective consultation, coordination, and cooperation. Currently, many of the relevant information "bits" are either unknown, changing or contested. Systems that provide more detailed and reliable information are a necessary basis for building more effective consultation, cooperation and coordination processes.

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<sup>10</sup> "Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level radioactive Waste in the United States," National Research Council, Committee on Transportation of Radioactive Waste (2006), Section S.2, pg. 11-12.

## 2.0 Calls, Response & Reasons, What-ifs

### 2.1 Calls

Calls for information useful for the purposes described above have come, not just from analysts, but from observers, advisors, stakeholders and participants in the current and prospective process of SNF transport. Examples include the National Academy of Sciences, the California Energy Commission, Section 180(c) implementation policy, the recent DOT/PHMSA rulemaking, the Western Interstate Energy Board, DOE/OCRWM/OLM itself. Here are few details and references:

**National Academies of Sciences: “Going the Distance.”** Focusing most directly on the purposes discussed in Sections 1.1 and 1.2 above, the National Academies recommended that DOE should undertake detailed surveys of routes to identify potential hazards, and take steps to avoid or mitigate such hazards through operational controls and restrictions.<sup>11</sup> The National Academies did not, however, specify what should be included in “detailed surveys,” or address the question how DOE should develop, validate and maintain the information, or consider how the information should be applied (and by whom) to identify and address hazards.

**California Energy Commission: “Nuclear Power in California: 2007.”** This status report was a major review of the state’s policy regarding nuclear power, and was not designed to focus on transportation issues in detail. A major conclusion, however, reads as follows: “The probability of extreme accidents can be reduced through route-specific analyses to identify and diminish potential hazards. Greater information sharing by DOE regarding spent fuel transport routes and plans is needed to allow state and local input and to gain public confidence in these shipments.”<sup>12</sup> Like the National Academies, the California report did not specify what “route-specific analyses” should include, or how the analyses should be conducted or applied. California does, however, reference an additional purpose for such information, one similar that discussed in Section 1.7 above.

**NWPA Section 180(c) Implementation: Assessment and Planning Grants.** NWPA Section 180(c) contemplates that affected states should receive assessment and planning grants from the Nuclear Waste Fund to conduct an “initial needs assessment.” This has resulted in elaborate discussion, in the DOE Transportation External Coordination (TEC) Working Group and other forums, regarding what an “initial needs assessment” includes, how the needs might be addressed, how the needs identified affect route selection, how initial assessments should be updated, whether assessments should assess “training needs” only or the need for safe, secure and uneventful transportation more broadly, and whether proposed funding allocations are adequate. These discussions have generally assumed that “initial needs assessments” would be ad hoc efforts, lead by a state’s radiological monitoring and emergency response agencies, but coordinated with local emergency responders and managers, as well as with local communities.

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<sup>11</sup> Ibid, Section S.2, pg. 10-11. Emphases added.

<sup>12</sup> Nuclear Power in California: 2007 Status Report, California Energy Commission, October 2007, pg. 24.

This inquiry does not intend to revisit these issues, but it does address several related “threshold” questions:

- What is the informational starting point for the assessment and planning grants contemplated by the NWPA? Must this be an ad hoc information collection effort, hastily organized among state and local agencies, three years before first shipment?
- Will there be “reasonable consistency” in the information assembled in various states? Or, will the process proceed from dramatically inconsistent bases in 40 states? If “reasonable consistency” is desirable, might it be better to think about this now, rather than 3-years before first shipment?
- Whatever its focus in a particular state, might not the initial needs assessment be more efficient and effective if the funded effort could focus on the assessment of needs, rather than on the hasty collection of a (probably inconsistent and defective) information base for such assessments?

Section 180(c) needs assessment engages two other purposes in addition to those referenced by the National Academies and the California Energy Commission: 1. Assessment of state-local emergency response capabilities (see Section 1.3), and 2. Development of state-local emergency response plans (see Section 1.4).

**DOT rulemaking to enhance rail transport safety and security for hazmat shipments.**

Purpose 1.9 above (route selection) discusses the route selection factors identified by DOT/RSPA for truck shipment of radioactive materials in “highway route controlled quantities” (HRCQ).” On April 16, 2008, DOT/PHMSA<sup>13</sup> released a not-dissimilar route selection process for rail shipment of “high-hazard” materials, including high-level radioactive waste. The interim final rule<sup>14</sup> requires rail carriers to: a) Compile annual data on specified shipments of hazardous materials; b) Use the data to analyze safety and security risks along transportation routes; c) Assess alternative routing options (based on risks assessed); d) Make routing decisions based on those assessments.

As minimum criteria for safety and security risk analyses, the rule sets forth 27 risk factors, of which 15 involve a rail carrier’s own facilities and operations (e.g. track attributes; rail traffic density), 7 involve the route environment (e.g. venues along the route; emergency response capabilities), and 5 involve the characteristics of the shipment (e.g. availability of practicable alternative routes; trip length). Under the rule, “each carrier will seek to obtain information from state and local officials regarding security risks to high-consequence locations along or in proximity to those routes.”<sup>15</sup>

Since it involves private rail carriers, implementation of the PHMSA rule differs from implementation of the DOT/RSPA guidelines for routing truck shipment of HRCQ. The Railroad Research Foundation (a not-for-profit foundation of the American Association of Railroads) will receive funding from the Dept. of Homeland Security to “develop a routing

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<sup>13</sup> Pipeline and Hazardous Materials Safety Administration.

<sup>14</sup> Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments, Federal Register/Vol. 73, No. 74, April 16, 2008, for incorporation in 49 CFR Parts 172 and 174.

<sup>15</sup> DOT/FRA Background Report, pg. 2. See Appendix D.

model that a railroad can use in complying with the rule.” Presumably, rail carriers can consult the model to select routes and alternatives—without accessing proprietary information about its competitors facilities or operations. The PHMSA rail routing process may incorporate detailed information on rail facilities and operations, but it may be a “black box” process: the underlying information and the processes for selecting routes and alternatives will be “opaque” in various degrees, both among rail carriers, and especially to other stakeholders. Whether such processes warrant “public confidence” remains to be seen. It would seem, however, that state and local stakeholders should at least be able to “spot check” the system: ‘our information on “x” is so-and-so; is your information the same or different, and if so, how?’

**DOE Repository SEIS: Affected Environment Related to Transportation.** In responding to the Draft Repository SEIS, WIEB pointed to the limitations of an exclusive reliance on RADTRAN to describe the environments affected by a national campaign for shipment of SNF and HLRW: “For national transportation purposes, the SEIS defines the “region of influence” as the area within one-half mile of the centerline of a rail or highway right-of-way, or a rail yard boundary. The analysis then uses RADTRAN 5 to estimate “off-link” radiation doses to “populations” within the one-half mile buffer. ‘Populations’ are based on 2000 Census data extrapolated to 2067..... These assumptions and methods may be a useful starting point for an assessment of a national transportation program involving thousands of miles of rail and highway routes in every region of the nation. However, it does not follow that the SEIS assumptions and methods constitute an adequate description of the affected environment needed for route and needs assessment in a campaign of this import. Such a description would include, not just estimated “populations,” but a systematic inventory of “features” (e.g. canyons and mountain passes, refineries and hazardous material industries, key infrastructure elements—e.g. bridges—and current conditions, hazardous materials flow, hospitals and nursing homes, stadiums and event centers, etc.), plus an inventory of state/local capabilities for addressing potential contingencies in various route segments. Some of these features and capabilities will be found beyond the half-mile buffer applied in the SEIS assessment. The inventories of “features” and “capabilities” should be available well before Section 180(c) and other campaign pre-planning efforts.”

The WIEB response to the SEIS also expressed concern that over-simplified description of the affected environment can lead to over-simplified assessment and counterproductive decisions. “Using representative routes and shipments generated by TRAGIS, and assumptions regarding ‘affected environment,’ the SEIS uses RADTRAN 5 and RISKIND to estimate the impacts of incident-free transportation and transportation accidents. Thus, ‘impacts’ are model calculations of projected latent cancer, vehicle emission fatalities, and accident risk..... The best possible estimates of latent cancer and vehicle emissions fatalities cannot fully describe the effects of a transportation campaign for cross-country shipment of the nation’s spent nuclear fuel and high-level waste over a 25-year period. Such estimates cannot describe the people’s perceptions of this material, their trust in agency managers and Congressional decision makers, or their response to perceived inequity or to contingencies. They do not fully explain the importance of ‘best management practices’ regarding such a campaign, or the special relevance of measurable goals and targets, and implementing programs, procedures and controls.”

**DOE/OCRWM National Transportation Plan.**<sup>16</sup> Though it does not directly discuss the information resources for SNF route characterization and assessment, or address how such information should be developed, updated, validated and shared, the need for detailed, featured route information is implicit in the DOE/OCRWM National Transportation Plan:

- In developing a system for transport of SNF and HLRW, DOE/OLM “will be guided by three principles: 1. Conduct a thorough, open and collaborative planning process with interested parties. 2. Develop a safe and secure transportation system and related infrastructure that is based on that planning. 3. Complete transportation system validation prior to starting operations. (pg. 2)
- Along with the critical decisions in transportation systems planning are “to develop relationships with key stakeholders having responsibilities for transportation and to establish operational capabilities.” (pg. 3)
- The “transportation system will be comprised of capital assets, the capability and personnel to operate the system, and an institutional program (that) engages stakeholders in a collaborative effort....to address issues. (pg. 19)
- “Participants in each phase (of national interactions) and the type and amount of information OCRWM shares will depend on the participant’s roles and responsibilities. (pg. 32)
- “With regard to local governments, OCRWM recognizes that local officials are uniquely qualified to provide information on transportation conditions and impacts within their areas of jurisdiction, and accordingly, are important participants in developing procedures for the transportation system.” (pg. 33)
- Key logistics development initiatives include: 1. Route identification, 2. Emergency preparedness (DOE Emergency Response Plan; Section 180(c) implementation; and 3. Technical assistance. (pg. 36-40).

How can DOE conduct thorough, open and collaborative planning without detailed, “featured” route information? Are not “relationships with key stakeholders” based in large part on a mutual understanding that relevant route-specific local information has been appropriately incorporated and considered? How can “collaborative engagement occur without reliable information on features of concern to stakeholders? How can such information be shared based on participants’ multiple roles and responsibilities?

All of the above NTP intentions go beyond current legal requirements, strictly interpreted. All reflect an implicit recognition of the “social risk”<sup>17</sup> dimension of a national campaign for SNF shipment, and a strategic conclusion that this dimension is most effectively addressed in the U.S. federal system by a process of informed stakeholder consultation and cooperation. (See Section 1.11.) As yet, however, DOE lacks the tools (and institutional relationships to consistently apply these tools) needed to deliver on its strategic conclusion and expressed intentions.

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<sup>16</sup> Pre-decisional Draft, July 16, 2007. The NTP is a product of the DOE/OCRWM Office of Logistics Management (OLM).

<sup>17</sup> “Going the Distance?” National Research Council, Committee on Transportation of Radioactive Waste (2006), Section 3.2, pg. 149-161.

## 2.2 Responses and Reasons

While the uses of and calls for more detailed, “featured” route characterization and assessment information are numerous, relatively little concerted action to generate, maintain, and distribute such information to stakeholders in a national SNF shipment campaign have been forthcoming. Why is that?

The major, very practical reason is that, using standard tools and procedures, the development and maintenance of such information over thousands of miles of rail and highway routes<sup>18</sup> crossing many states and local jurisdictions are daunting tasks—far exceeding current state agency resources or prospective federal funds. Even if such information were available, there is no current capability for distributing it in useful formats to those that have specific responsibilities along specific segments of a regional or national system. The agency response to these circumstances is speculative, but perhaps useful in our inquiry:

**DOE/OCRWM/OLM.** For DOE/OCRWM, the reason for the limited concerted effort may be that the shipment campaign, along with actual application of such information for Section 180(c) planning grants and other purposes is still 10 years or more in the future. Currently, DOE/OCRWM is focused almost entirely on its license application for a Yucca Mountain repository. Within OCRWM’s Office of Logistics Management, the focus is on the development of a National Transportation Plan, detailing the schedule, mode, equipment and operating practices for the anticipated campaign. If the license application is received, its focus will then shift to Nevada rail spur construction. A concerted DOE effort to develop the information required to conduct actual hazards assessment, or route assessment, or needs assessment, or emergency response plans is not a high DOE priority now, and may not be such five years from now.

Another factor for DOE may be that it is still at issue (despite the calls) whether detailed, featured route assessment information is truly warranted. Technically-oriented program participants often believe that any schedule, mode, route, equipment and operational practices that meet technical (e.g. RADTRAN) criteria should be acceptable. Special efforts to go beyond such criteria in the case of a national campaign for cross-country shipment of the nation’s SNF are unwarranted, as are special efforts to review and gain local acceptance for shipments that are, after all, technically safer than the average shipment of gasoline, chlorine, or propane.<sup>19</sup> The greater the scale of funding and effort required to provide more detailed and featured route assessment information, the greater the inclination to adopt the technician’s view.

**Affected states and localities.** For states (and their potentially affected localities), the situation is oddly comparable. Using standard procedures, the task of assembling information for the range of purposes outlined above is daunting. Such information would

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<sup>18</sup> DOE’s “proposed action” presented in its Repository SEIS (Table G-10) anticipates 2289 dedicated train rail shipments (5.8 million shipment miles), and 2646 overweight truck shipments (6.6 million shipment miles.)

<sup>19</sup> Holders of these views may miss two points, however: a) DOE/OCRWM has committed to conduct this unprecedented campaign with special and ongoing efforts to involve stakeholders, including affected localities; and b) Given the societal risk in SNF transport, DOE may be unable to transport successfully unless it makes a full-faith and convincing effort to do “a.”

have to be assembled from hundreds of state and local agencies in a complex and costly effort that prevails on already overburdened officials, and whose results would likely always be inconsistent and outdated, and therefore never entirely satisfactory or confidence inspiring. Even if for good purposes, do we really want (or have the time, energy, and funding) to do this?

Another factor for states is their understanding, based on the Nuclear Waste Policy Act, that it is the responsibility of the generators of spent fuel and high-level waste to pay for all the costs associated with safe, secure and uneventful. But, detailed, featured route information for thousands of miles of prospective SNF shipment routes would (using standard processes) require major and ongoing effort of state and local agencies, which, if not included in the OCRWM program, become yet another unfunded federal mandate.

### 2.3 What-ifs

This pilot inquiry is premised on several “what-ifs”:

- What if emerging technology makes it dramatically more efficient to collect and maintain detailed, featured information on thousands of miles of prospective SNF transportation routes?
- What if these same technologies make it possible to distribute this information to those that need it for specific purposes, regarding specific route segments?
- What if the role of state and local agencies (and of other stakeholder contributors) is mainly local validation of information, rather than the more time-consuming and costly processes of collection and update?
- What if these processes (over time) generate more consistent and up-to-date information across thousands of miles of prospective SNF transportation routes?
- What if local route assessment and confidence building could begin from similar bases in community “A” (state #1) as in community “Z” (state #40).
- In other words, what if emerging technology makes it possible to collect and maintain/update route-specific information, say, 10-times more *efficiently* (i.e. the cost of the process), say, 2-times more *effectively* (i.e. the scope/quality/credibility of the results), and, say, 5-times more *purposefully* (i.e. distributions to users with various purposes regarding specific route segments)?

Might it then be possible to get beyond the barriers discussed above? This report makes no prediction. The judgments will be made by states, DOE, and other stakeholders in the prospective SNF shipment campaign. This report provides a beginning basis for such judgments, by assessing the capability of emerging technology for these purposes, and by considering what is needed to adapt the technology to meet the challenges of route characterization and assessment in a prospective national campaign for transport of the nation’s SNF and HLW.

### 3.0 Choosing a Context and Basis for the Pilot Inquiry

Among the plethora of “emerging technologies,”<sup>20</sup> one seems most applicable to the purposes outlined in Section 1 above: IRRIS,<sup>21</sup> an enterprise Web portal created by GeoDecisions, a division (since 1996) of Gannett Fleming, Inc. Headquartered in Camp Hill (PA), Geo Decisions is a spin-off from the Office of Remote Sensing of the Earth’s Resources at Pennsylvania State University.

#### 3.1 The Qualifications of IRRIS (for purposes outlined in Section 1)

In contrast to many special purpose technologies and tools (e.g. TRANSCOM, RADTRAN, GoogleEarth, ESRI GIS), the focus of IRRIS is integration and openness. It seeks to make multiple tools (in current or emerging forms) available to users via a “web portal” (e.g. Internet Explorer), and allows (actually encourages) qualified users to add to the information base or the modeling capabilities. Here are some features that lead us to select IRRIS as the context and basis for the pilot inquiry:

- **IRRIS is “web-based”:** Users access base data and modeling results through Internet Explorer. Special programs (with their multiple learning curves, each creating potential “priesthoods” and “fiefdoms”) are not required to access IRRIS data or its modeling results. (There is, of course, a learning curve in dealing with IRRIS, but this need not be imposed on each potential user in his/her own agency.)
- **IRRIS was originally developed for DOD:** IRRIS was originally developed by the U.S. Dept. of Defense (to DOD specifications) to assist military personnel in accessing timely information on factors (e.g. road conditions, construction, incidents, weather) that might interfere with military shipments. The implications include: a) Portions of the monitoring, tracking, and information distribution capabilities developed for DOD are now available to others; and b) The security processes developed for DOD<sup>22</sup> are also now available to others.
- **IRRIS is an “open system”:** Information from various sources (e.g. TEPP needs assessments) can be incorporated, with appropriate protections for the providers.<sup>23</sup> Also, modeling capabilities (e.g. DOE’s RISKIND) could be incorporated and applied (to the IRRIS information resource), with results distributed to users as required.

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<sup>20</sup> A March 2008 Workshop of the Commercial Vehicle Safety Alliance (CVSA) RAM/Security/ITS Committee provided a valuable overview of emerging technologies relevant to hazmat transport. Prospective workshops (if supported by continued funding) provide a useful forum for monitoring, comparing, and assessing potential applications.

<sup>21</sup> Originally “IRRIS” was an acronym for “Intelligent Road Rail Information Server.” However, the system now has water and air as well as road and rail applications. GeoDecisions now prefers the optical allusion: IRRIS (iris) is “your eye on” transport-relevant information.

<sup>22</sup> Users are “role-based,” receiving specified types at appropriate times for authorized purposes.

<sup>23</sup> The pilot study has already incorporated information on nuclear plant locations, shipment origins without direct rail access, and potential railheads accessible from such origins.

- **IRRIS data is geo-referenced.** Among IRRIS resources are ESRI GIS, Global positioning, and earth imaging (e.g. Google earth): The first implication is that most, if not all IRRIS information is “geo-referenced,” and IRRIS has processes for incorporation of additional geo-referenced information. For any route segment of concern to a particular user for a particular purpose, it’s possible to receive a map showing, for example, the location of the bridge (and its condition), the school (and its enrollment), the fire station (its major equipment; its staffing and training levels), the nearby refinery and environmentally-sensitive areas, etc. Also, if an inspector notices a dangerous condition, it’s possible (via GPS) to incorporate that into the system-wide database.

### 3.2 The Qualifications of IRRIS (for transport operations purposes)

The above features provide a sufficient basis for choosing IRRIS as the context and basis for an inquiry on the mostly route planning and assessment purposes<sup>24</sup> outlined in Section 1. It’s worth noting, however, that, should IRRIS prove useful for these purposes, its integration focus and openness make it also potentially applicable in shipment operations:

- Route conditions (e.g. route congestion), incidents (e.g. an overturned truck of watermelons), and weather (e.g. the approaching ice storm) can all be accessed via IRRIS, in near real-time.
- To this can be added other information (e.g. the location of the nearest safe parking or safe haven) needed in operational decisions.
- Shipment tracking<sup>25</sup> is included in IRRIS. Tracking can be programmed to provide notifications (to those authorized) of the approach of a shipment to a state or local boundary.
- Shipment monitoring (mechanical and/or radiological) can also be incorporated and distributed as appropriate to those authorized to receive it.

### 3.3 Questions for the Pilot Inquiry

None of the above qualifications warrant the adoption of IRRIS for SNF route characterization and assessment purposes, much less for operations/tracking/monitoring applications. The qualifications do, however warrant a pilot inquiry:

- What’s required to apply IRRIS for SNF route characterization and assessment purposes?
- To what extent is existing data sufficient, acceptable or insufficient for such purposes?
- How might the insufficiencies be remedied?
- Amongst the ocean of information available, which useful packages might be assembled for which purposes?
- How do stakeholders experienced in assessment or operations review such packages?
- How might users also be contributors—improving or updating the resource as they use it?
- What are the prospective annual costs? Are these in the millions of dollars, in the hundreds of thousands, or in the tens of thousands?
- What are the costs of providing similar information and capability (nationwide, for thousands of miles of prospective routes) *without* a resource like IRRIS?

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<sup>24</sup> To test a specific application, the first phase inquiry will assess and test the application of IRRIS in application of current route comparison guidelines. (See Section 1.10 and Appendixes B and C.)

<sup>25</sup> Tracking in the “featured” route environment discussed above.

- What barriers does IRRIS present for migration to alternative future systems that may exceed IRRIS capability?
- Can users for the (chiefly planning) purposes of Section 1 also be users during shipment operations?
- Can officials with current planning or operational responsibilities regarding DOE/EM or other hazmat shipment also become users and contributors to an IRRIS-based system?
- Could systems that support SNF route characterization and assessment purposes also provide parts of the data required by the new DOT/PHMSA rule to enhance rail transport safety and security?

Not all of these questions will be answered definitively in the current pilot inquiry. Some can be addressed, however. The results will provide a basis for next steps—smaller or larger, tentative or bold.

### 3.4 Institutional Arrangements in Application of Emerging Technologies

The March 2008 CVSA workshop mentioned above suggested the crucial importance of institutional arrangements in the effective adoption and application of emerging technology. This is perhaps particularly the case in transportation applications, which involve significant portions our federal system—multiple federal agencies, multiple states, each with its own agencies and relationships with localities, private carriers, railroad owners/operators, unions, etc. Whatever the potential of emerging technology, that potential will be realized only via enlightened institutional arrangements, the development of which constitutes a worthy task for DOE’s Transportation External Coordination Working Group and the state regional groups engaged in the DOE transportation program.

One summary of the CVSA workshop<sup>26</sup> focused on the institutional challenges posed by emerging technologies:

- **Emerging capabilities for SNF shipment.** The technology for “smart” transportation tracking and monitoring is “emerging” rapidly, led by private (not federal government) initiatives. There is little question that the capabilities when spent fuel shipments begin (2017+) will be vastly different and more integrated than what is currently “in the field” (i.e. the technologies presumed in most federal-state programs).
- **The federal role: requirements & standards.** While the energy and innovation in technology development will come from the private sector, federal “ground rules” for such development are needed. Federal regulations must require shippers and carriers to provide specified data, and require that technologies developed for the purpose adhere to certain standards—e.g. “open architecture,” interoperability, modular, field tested before deployment, role-based (discrimination regarding who has access to what, under what circumstances).
- **State roles in adoption/application.** States will need to participate in the adoption and application of these technologies, reviewing and revising current requirements as they gain confidence in the reliability of the information received.

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<sup>26</sup> WIEB meeting summary: March 29, 2008

- **Technology selection or winnowing.** In addition to setting general standards (#2 above), federal agencies may need to play a role in technology selection. An (already outdated) data base shows 22 vehicle disabling products, 63 satellite tracking products, 11 cargo locking products, 52 truck/trailer tracking products etc. Which should be applied? Laissez faire leads to confusion, special dealing, and sub-optimal selection. Federal agency selection may adopt already out-dated, sub-optimal performers. A “DARPA” (open competition, with specified requirements) process could lead to better outcomes.<sup>27</sup>
- **Role-based access to integrated information.** While the information provided by emerging technologies may be highly integrated, access to the information must be “role-based,” with fairly elaborate control over who has access to what information (in what forms) under what circumstances. This will pose challenges for state agencies, which must develop confidence in the information base generally, including their own limited access to the whole.
- **Exception-based monitoring.** Integrated information systems can provide better information (e.g. commodity flow data) at less cost. One example is to make monitoring “exception-based”: monitors are alerted when certain pre-specified kinds of incidents happen to certain types of shipments in certain locations, and then receive information relevant to addressing the particular situation (perhaps, given the resources available). This can save money and improve performance, but the savings may need to be re-directed to systems-support or other purposes.
- **Current and prospective.** To say that the field is rapidly evolving is not to say that everything is available now. For example, monitoring/tracking of tractors is more advanced than that for trailers and casks. We should design applications based on what is in prospect while specifying what is still needed and processes for winnowing and adoption/application.

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<sup>27</sup> The Defense Advanced Research Projects Agency (DARPA) was established (in response to the Soviet launching of Sputnik) to look beyond today’s known needs and requirements, and to sponsor projects of high but uncertain payoff to bridge the gap between current and leading edge technologies and capabilities. DARPA offers lessons in how to “somewhat influence the directions of a much-larger-than-DoD market” in microelectronics, computing and network communications, including innovative R&D business practices and contracting arrangements. DARPA literature notes that “transitioning technology—getting technology from research and into use—is a contact sport. Many different types of organizations may need to be involved. ....This involvement requires personal contact between the people developing the technology and those destined to receive it.” See “Bridging the Gap,” DARPA, February 2007.

## 4.0 IRRIS Capabilities; Requirements for SNF Route Characterization and Assessment

This section reviews IRRIS capabilities as these are described by GeoDecisions.<sup>28</sup> In some cases, the GeoDecisions language is parsed to assist in an item-by-item review of claims. Terms that may mean something more or different to “technical insiders” than to the rest of us are explained in footnotes. Footnotes are also used to make comments pointing to potential applications in the current inquiry (focused on the SNF route characterization and assessment purposes outlined in Section 1.0) or to prospective applications (building on the results of the current inquiry) in SNF operations, monitoring and tracking.

**4.1 Overview.** IRRIS is a Web-based portal<sup>29</sup> to geographic and infrastructure information that is proven to be an effective incident management, tracking, and decision-support application.

IRRIS is an easy-to-use logistics tool<sup>30</sup> that uses advanced information technology, geographic information systems (GIS), and location based services<sup>31</sup> (LBS) to enable users to be more proactive in tracking and managing hazardous materials and assets (e.g. transmission lines, wind energy) through an interactive mapping interface.

IRRIS technology is designed to provide timely static<sup>32</sup> and near real-time information about assets, road conditions, traffic, construction, incidents, and weather to facilitate both general management and incident management of assets using its versatile “common operating picture”<sup>33</sup> (COP).

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<sup>28</sup> The text and figures are from a summary of “IRRIS Technology” provided to WOEB on April 2, 2008.

<sup>29</sup> “Web-based portal”: Users can assess information via the internet (e.g. Internet Explorer), without special knowledge of GIS or other specialized tools. IRRIS is also sometimes described as an “enterprise information portal” (EIP) or “corporate portal.” These terms focus on the use of integrated information systems to integrate people and processes across organizational boundaries. By providing a secure but unified access point (e.g. a web-based user interface), decentralized content contribution and content management can (with appropriate institutional arrangements) promote consistent applications and more integrated decision making.

<sup>30</sup> The potential application of “logistics tools” is mainly in SNF shipment operations, rather than the route characterization and assessment purposes of this inquiry.

<sup>31</sup> An example of “location-based services” is global positioning systems. For example, IRRIS information on a local fire station can be validated, updated and/or elaborated using global positioning. This has potential to greatly “streamline” the information resources needed in SNF route characterization and assessment.

<sup>32</sup> “Static” presumably characterizes much of the information on route conditions, route environments, etc. “Near-real time” characterizes information on weather, shipment location, shipment monitoring characteristics, route congestion, events, etc. Of course, “static” information (e.g. school enrollment, hospital capabilities) change, and the processes for validation, updating and/or elaborating such information are an important challenge. However, for purposes of SNF transportation planning in, say, 2012, such information may reasonably be considered “static.”

<sup>33</sup> A “common operating picture” means that all participants, whatever their roles or areas of (geographic or subject matter) focus, draw on the same integrated information system and tools. The

In addition to collaboration tools supplied by the IRRIS dashboard<sup>34</sup> and presentation utilities, alerts and notifications<sup>35</sup> enhance users' abilities to adequately prepare for and respond to incidents or accidents.

IRRIS is a standard-compliant system,<sup>36</sup> so it can easily incorporate information from various databases and data feeds. This flexibility allows IRRIS technology to accommodate the varying needs of its users by incorporating existing or requested databases<sup>37</sup> and systems requested by clients. By providing the capability to visually display information from numerous sources, IRRIS improves the ability to assess information crucial to monitoring assets.

Specific IRRIS capabilities include:

**4.2 Detailed Mapping.** IRRIS uses commercial Web-based GIS software (ESRI) to provide its users with comprehensive map building capabilities. IRRIS is capable of integrating critical infrastructure data layers.<sup>38</sup> These IRRIS-specific layers include:

- Railways, highways, bridges, and local roads
- Ports and military installation
- Dams and water plants
- Nuclear plants and energy facilities
- Airports

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GIS technician and the ER manager (whether located in Maine, Alabama or Nebraska) have access to the same underlying system.

<sup>34</sup> The IRRIS “dashboard” is a template that draws on the underlying databases to provide the user with the information needed for specific purposes. Sometimes called “templates,” these need to be designed and user-tested, using IRRIS “presentation utilities.”

<sup>35</sup> IRRIS capabilities to provide alerts and notifications are potentially applicable in SNF shipment operations, monitoring and tracking.

<sup>36</sup> The geospatial community has established standards for data collection and quality (Federal Geographic Data Committee 2008). These standards enable entities to collect spatial data in a consistent fashion, with the same characteristics across the entire United States. This uniformity provides confidence in the quality of the data. While increasing amounts of data (assembled by federal, state, local and private agencies) complies with these standards, much, including some of direct relevance in this inquiry, is not. For example, is DOE TEPP data on local emergency preparedness “standard compliant”? If not, what institutional arrangements might, over time, move it to such status? At any point in time, an IRRIS-supported system for SNF route characterization and assessment (or shipment operations) may draw on information that is and is not “standard compliant.” Such a system should “tag” data that is and is not standard compliant, as well as data that has been updated, when, and by whom.

<sup>37</sup> This inquiry has already arranged for incorporation of information on shipment origins without direct rail access, and the railhead destinations for intermodal shipment from such sites.

<sup>38</sup> A substantial portion of the current inquiry will review the IRRIS “data dictionary” or “meta-data.” What portions of the substantial existing data resource is useful in SNF route characterization and assessment? What are the limitations of existing data for our prospective purposes? Do we know of resources or processes that might address such limitations? What processes are required to incorporate such resources or processes?

- Utility information
- Emergency response facilities.

IRRIS' mapping capabilities are flexible to meet the needs of users who have varying duties and responsibilities.<sup>39</sup> Personnel can build national, regional, or localized segment maps. Maps are customized so that users can select a geographic area of interest based on user-defined criteria<sup>40</sup> such as address, phone number, map coordinates, and map overviews.

Once a map is created, IRRIS' point-and-click interface<sup>41</sup> makes it easy for all users to navigate maps (zoom or pan) and access reports. Users can toggle data layers on or off<sup>42</sup> in the map legend at their discretion. Most of the layers have "clickable" detail reports for viewing attribute information about specified features on the map.

Specialized map utilities<sup>43</sup> provide additional functionality and analysis such as calculating the distance between selected points, exporting map data, and determining latitude/longitude coordinates.

A Save Map, Query, Routes, and Tracking Data tool preserves all user map settings and layers, dramatically reducing display times, and enables the user to share a map with others. This is an excellent collaboration utility that allows users to create a map or query that can be accessed by all users in the IRRIS Dashboard.<sup>44</sup> With the use of annotation tools, users have the ability to annotate the maps with custom text, colors, and symbols.<sup>45</sup>

The Geofence tool allows users to draw closed polygons on a map and set them as restricted zones for alert or notification purposes. Geofences can also be added by specifying a distance around a point or feature to further enhance the users' capacity to analyze their maps (see below).

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<sup>39</sup> Prospective users include people with widely varying responsibilities, located in various federal, state, local, and private agencies, concerned with various aspects or segments in a national transportation system, at various phases of a 25-30 year shipment campaign.

<sup>40</sup> In our case, the criteria are likely to involve a route segments, or local service area, or a key facility (e.g. intermodal facility) and its vicinity.

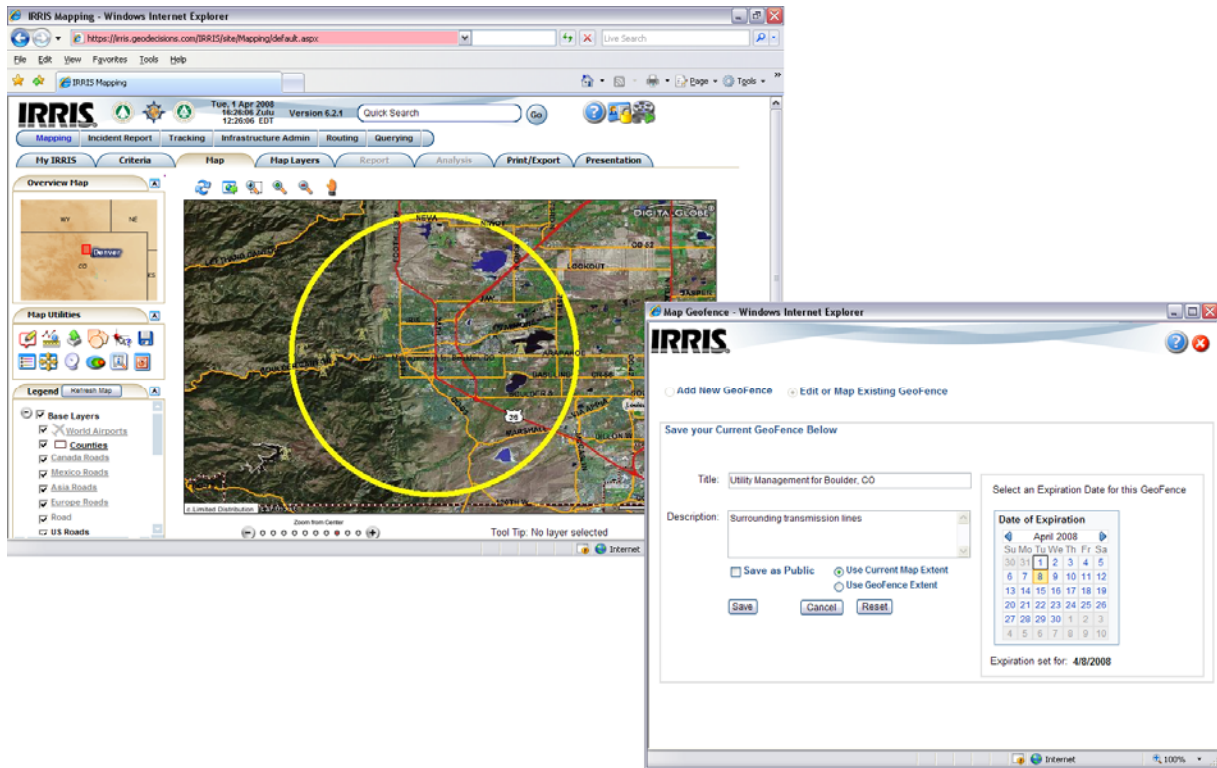
<sup>41</sup> Accessing information about map features: nuclear plants, schools, bridge conditions, etc.

<sup>42</sup> A feature which assists in managing "information overload" while using a massive information resource. People with differing responsibilities (fire, hospitals, roads, etc.) can access "layers of particular relevance.

<sup>43</sup> These appear to include drive time distance from facilities (e.g. fire or police stations). It is not clear whether the utilities referenced include routing, hazard prediction (HPAC), etc.

<sup>44</sup> Different users could access different maps (each with information relevant to particular roles and responsibilities) while drawing on the same shared data resource.

<sup>45</sup> Annotation tools could allow users to contribute to data validation, update & elaboration.



**4.3 Near Real-Time Information.** IRRIS includes several optional real-time data sets<sup>46</sup> to assist with logistics and decision-making that can be integrated into the application for users for an added fee (paid to third-party data providers). The data includes:

- Weather
- Route and port cameras
- Traffic speed and incidents
- Roadway construction information.

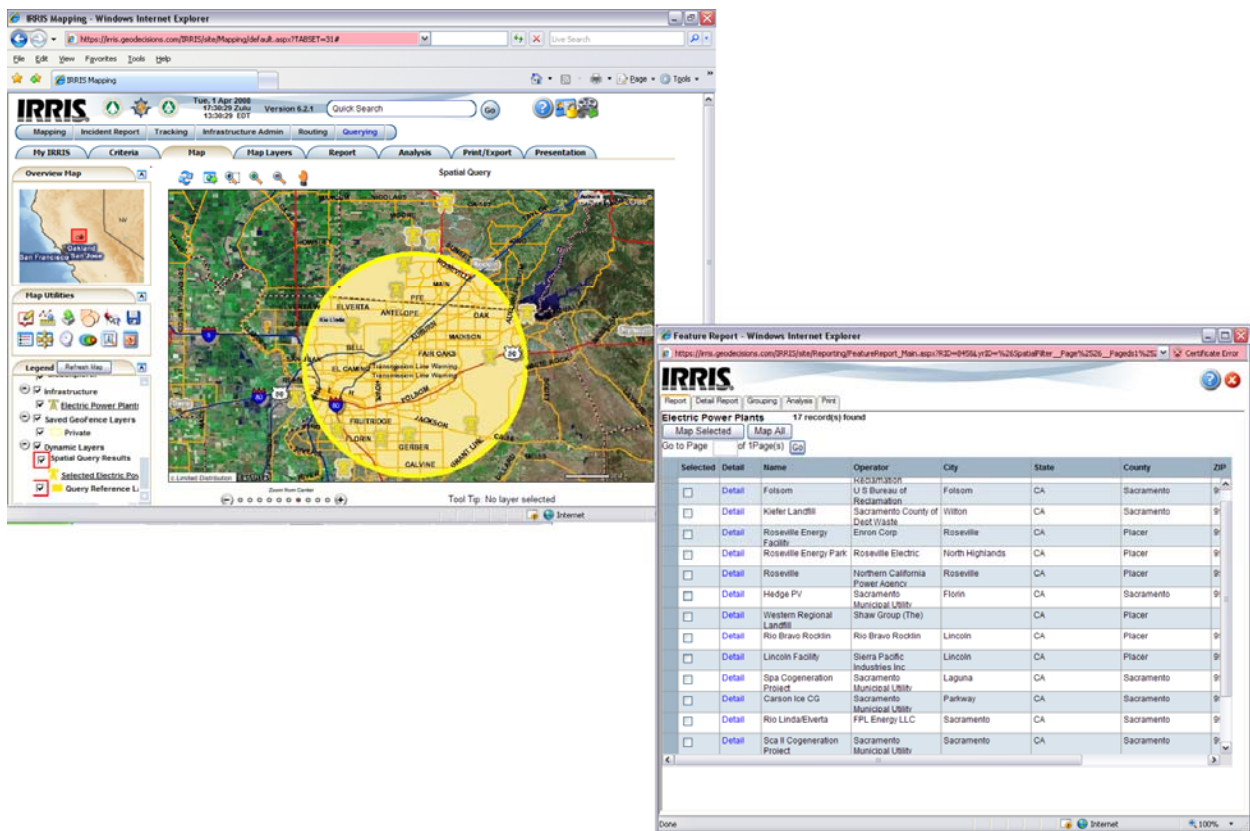
**4.4 Access.** IRRIS provides users with easy and secure access to the information system. The user-friendly interface allows the user to maneuver through the software without technical GIS technical training. Additionally, administrative authorization and user passwords<sup>47</sup> keep the application and its supporting data secure.

<sup>46</sup> These data sets appear most relevant to SNF shipment operations, monitoring and tracking. However, an accumulation of certain “real-time” (e.g. times when segment “x” on route “y” is highly congested, or closed due to weather conditions) could be useful in SNF route characterization and assessment.

<sup>47</sup> This “role-based” access to (different portions of) the data bases for different purposes is key to development and use of a resource shared (for SNF route characterization and assessment) by literally hundreds of federal, state, local and private agencies. For current (pilot study) purposes, the importance is to know that the tool exists and has been tested in application for military purposes. Installation would require an institutional process to sort out who has access to what, when, and for what authorized purposes.

**4.5 Database and Spatial Query.** IRRIS allows users to check the location and status of asset information through a query tool. The Query Builder interface guides users through the process of building sophisticated database queries to view the textual data in a tabular format.<sup>48</sup> The Query Builder allows users to set multiple parameters using “and/or” statements and common SQL operators (e.g., equals, does not equal, like) without experience in SQL. With this tool, inventory can be monitored with specific information in mind by attributes. IRRIS’ Query Builder also enables users to display the results of the query on a map.

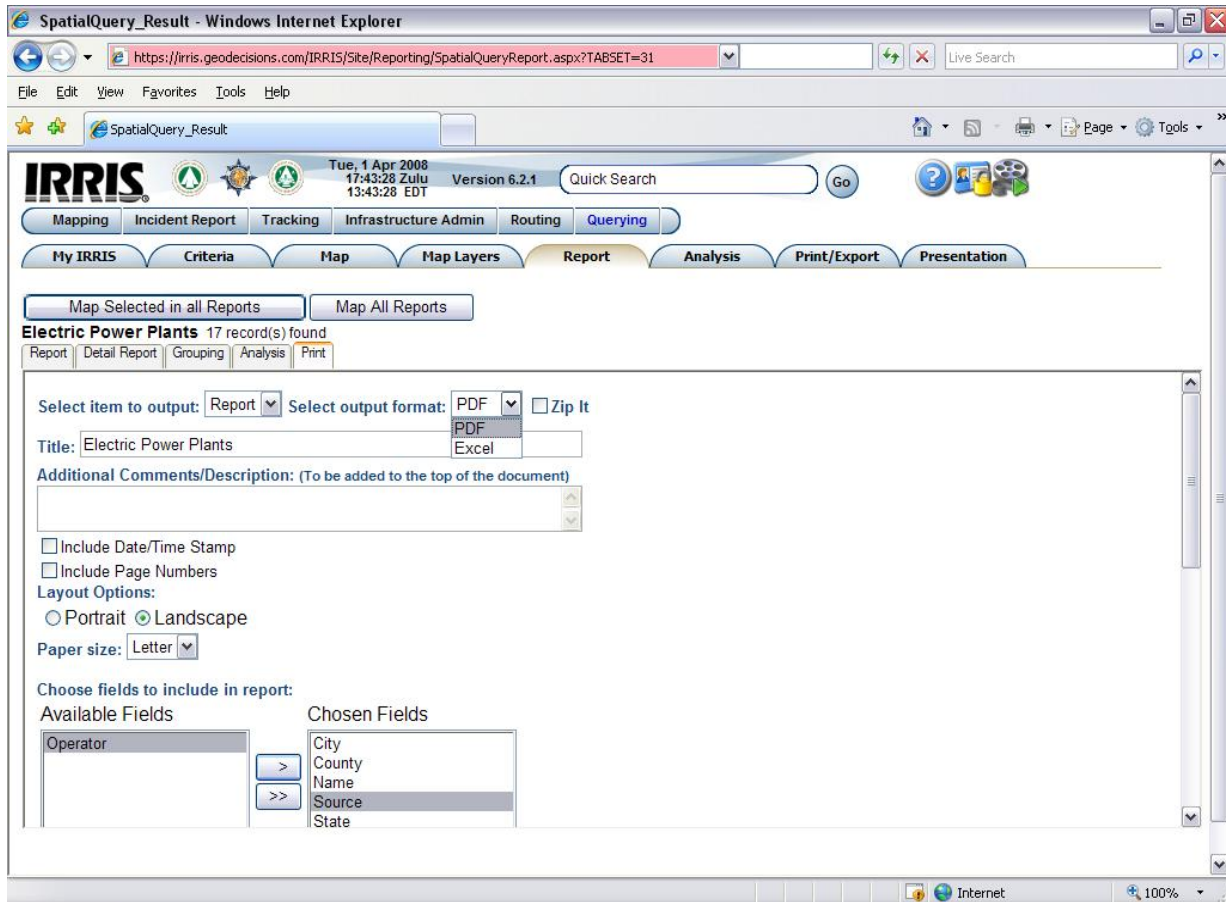
A second component of the query builder is that Spatial Query uses implicit spatial relationships to allow users to determine what and how many resources are within a given geographic area. Spatial operators enable users to search for features that touch, contain, are contained by, are within a certain distance of, or overlap a point, line, or area on the map. Spatial querying helps users answer strategic questions such as, “How many hazardous materials vehicles are located within a five-mile radius of this location.” (See figure below.)



**4.6 Reporting.** Standard reports can be easily generated with information regarding the location, origin, destination, status, quantity, and history of an asset. This feature can be extremely beneficial by allowing users to obtain and present important information.

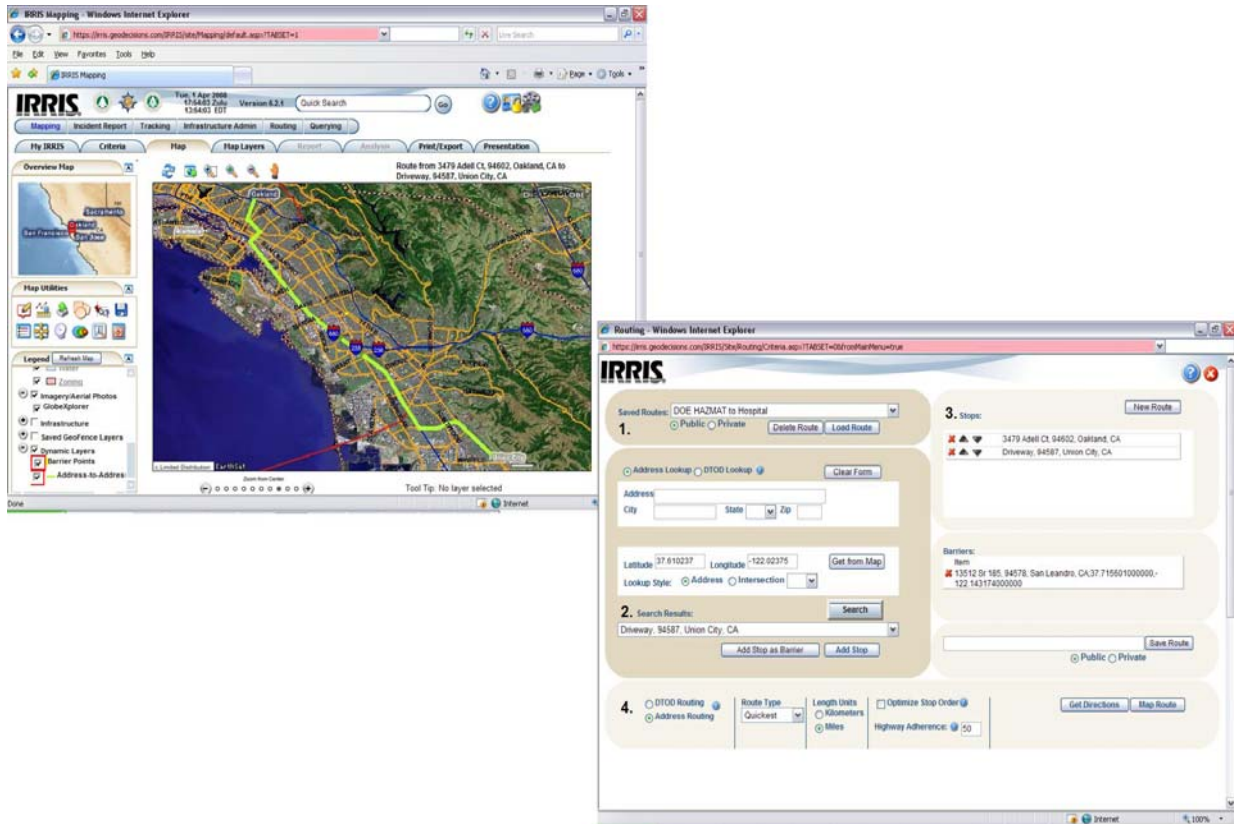
<sup>48</sup> The potential exists to develop “templates” (available for any route segment) of information relevant for particular purposes, linked to maps showing the relation of features to one another. For example, relevant sets of templates might be distributed along with Section 180c planning and assessment grants, allowing states to get more quickly to the “meat” of the process.

Reports can also be created based on specified criteria required by the user (e.g., querying, checking relevant attributes). From the databases connected to the IRRIS software, reports can be customized by a query or Quick Search. The reports can then be mapped using interactive report tool features on the map view. This can help to produce even more detailed reports by point, circle, or polygon as often as needed. With the IRRIS Geofence Tool, private geofences can be created to generate maps and site-specific reports for an area. All reports can be exported into PDF or Excel formats for the user's convenience, as demonstrated by the following figure.



**4.7 Routing.** IRRIS provides users with accurate turn-by-turn, address-to-address, or latitude/longitude driving directions with total drive time, mileage, and maps to guide and monitor the various transportation types. The IRRIS routing module<sup>49</sup> is capable of calculating driving directions using the fastest or the shortest route, and can also route around barriers.

<sup>49</sup> The pilot inquiry will determine how fully comparable these tools are to those in TRAGIS. If they are comparable, it may be possible to apply them to the richer, more featured IRRIS information resource. If they are not fully comparable, it may be possible to export information from IRRIS for TRAGIS routing analysis.

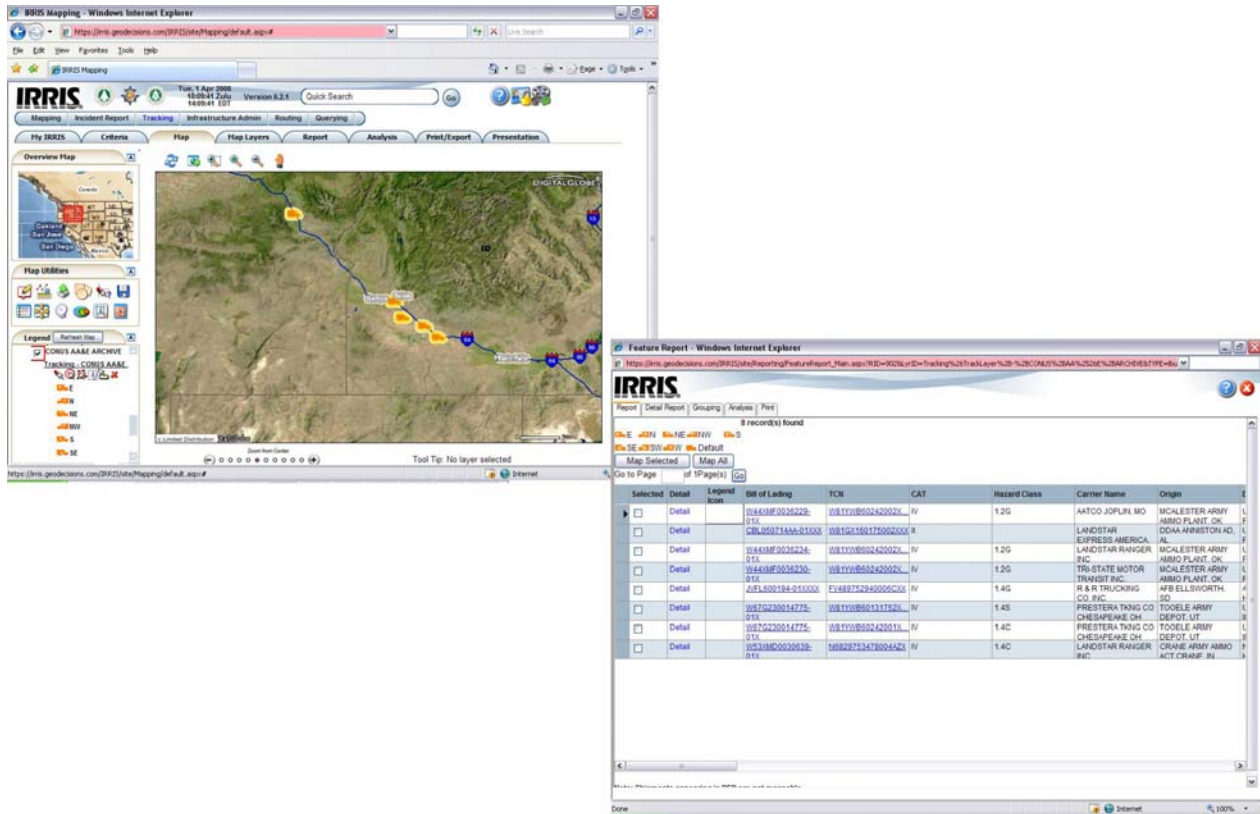


**4.8 Alerting.** IRRIS has unique messaging capabilities and uses a range of communication systems and tools, such as PDAs and phones. The alert and notification system can create buffers, or fences, around designated routes that trigger an alarm or notification message should a feature move outside the defined route or area. An alert can be set up to notify users by e-mail or SMS in the event the alert is violated.<sup>50</sup>

**4.9 Tracking.** IRRIS offers its users a tracking tool that allows for detailed reporting and querying tools to provide Total Asset Visibility (TAV) to track thousands of assets by truck, rail, or ocean vessel. It allows users to: a) accurately monitor and track the location of resources on a map in real-time; b) quickly generate reports for specified assets (e.g., historic movements); and c) effectively and easily query both the spatial data (e.g., “Show me where all of the vehicles are within 50 miles of a location”), and also allows a user to view resource details such as contents or weight. These results can then be displayed in both tabular and mapped formats.

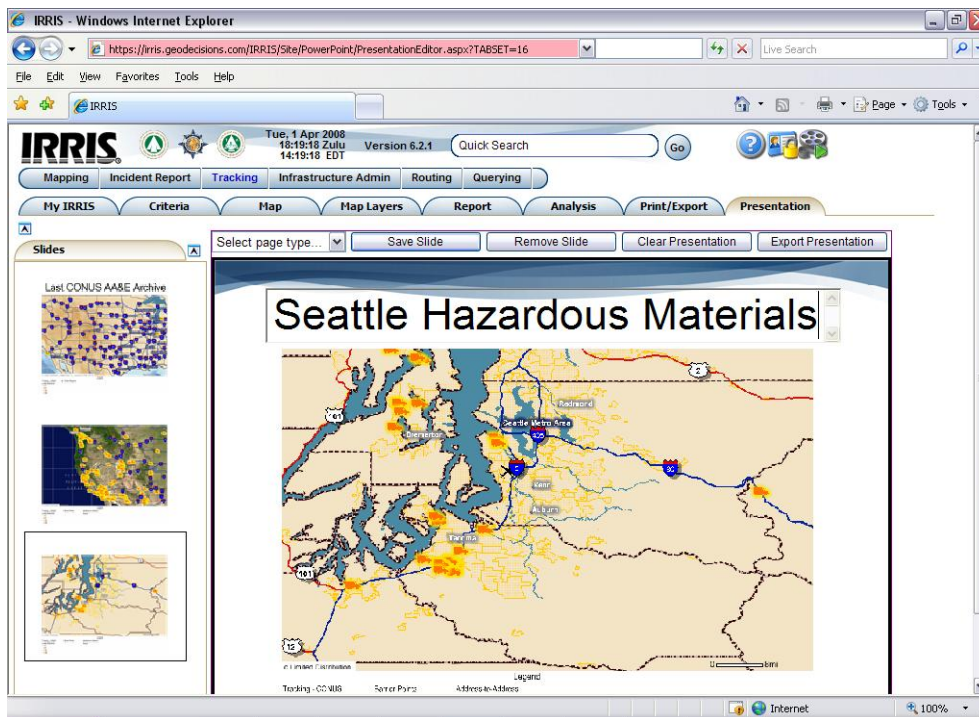
Users also have the ability to query and report on information from any of the data feeds. A Query Builder enables users to perform searches based on one or multiple criteria. For example, resources can be located by searching the destination site, unique ID, date of departure, and shipment name, as well as a multitude of other database details. Once records are retrieved, a map can be built showing the last reported location or the historic track of the shipment. (See figure below.)

<sup>50</sup> These tools are clearly applicable in SNF shipment operations, less so in planning phases. If IRRIS is applicable in SNF route characterization and assessment, these applications would then create more fully featured information for tracking, notification, and other SNF shipment operations.



**4.10 Analysis and Presentation.** One of the most important tools that IRRIS offers is the ability to analyze and present the data integrated within the application. IRRIS can build various types of charts (e.g., pie, bar, column) from data generated by reports and queries. Users can create a Microsoft PowerPoint® presentation of a map or a collection of maps with the PowerPoint Builder tool. Each of these features allows the user to better examine and present the information when collaboration is necessary.<sup>51</sup>

<sup>51</sup> The pilot inquiry will assess and test these capabilities, which seem applicable, not just in reporting but in the processes involved in SNF route characterization and assessment.



## 5.0 Phases of Inquiry and Next Steps

Given the range of purposes, the scope of the prospective SNF shipment campaign, and the complexity and evolving nature of the IRRIS system, pilot testing of IRRIS must occur in phases, with stakeholder review and evaluation at each phase. The current phase focuses on the potential application of the current IRRIS system in SNF route characterization and assessment, specifically to current (HM-164) route comparison guidelines. (See Section 1.10 and Appendixes B and D2.) Subsequent phases will depend on the results from the first phase, and may extend the focus to an evolved IRRIS system (additional or more detailed information resources, distribution and interaction features, supporting institutional arrangements) and/or operations. The following next steps will be executed by WIEB (with support from Black Mountain Research and GeoDecisions) with continued FY'09 funding from DOE/OCRWM:

- 5.1 More detailed and focused review and assessment of IRRIS capabilities. An on-site review is planned. GeoDecisions will cooperate in this review.
- 5.2 Obtain, review and assess the current IRRIS “data dictionary,” describing the source, coverage, status, and detail of current IRRIS data layers. This will focus on selected portions of potential relevance in SNF route characterization and assessment. GeoDecisions will cooperate in this review.

- 5.3 Review and assess the IRRIS capability for “role-based” and “web-accessed” information validation, update, and elaboration. These capabilities will be reviewed in general, and (given coordination and cooperation with DOE/EM and Technical Resources Group, Inc.<sup>52</sup>) with reference to a particular resource not now included in IRRIS.
- 5.4 Review and test the IRRIS capability to formulate and distribute task-relevant templates (maps and relevant data) using IRRIS. One or two simplified examples will be formulated for testing.
- 5.5 Test the IRRIS capability to incorporate additional information. Fairly simple examples (e.g. intermodal shipment origins) have already been accomplished. More advanced examples could be TEPP needs assessment or FRA shortline railroad assessment.
- 5.6 Review and assess selected IRRIS analysis tools—e.g. calculation of drive time distances from/to specified facilities.
- 5.7 Review and preliminarily assess selected IRRIS modeling capabilities—e.g. routing, HPAC.
- 5.8 Stakeholder review of the first phase pilot inquiry results. Focusing on SNF route characterization and assessment, a small group of stakeholders will be asked to provide review and comment.
- 5.9 Preliminary identification of next phase options, next steps and costs.
- 5.10 Report on the above, in writing and perhaps at the upcoming WM Conference.

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<sup>52</sup> TRG is DOE/EM’s management contractor for the TEPP program.



## **Appendix A: Prospectus for HLW Committee Review (Apr. 23, 2008)**

### **PILOT STUDY TO EVALUATE THE USEFULNESS OF A NEW TOOL FOR ASSESSING ROUTE CONDITIONS ALONG ALTERNATE ROUTES, AND STATE-LOCAL EMERGENCY RESPONSE CAPABILITIES AND NEEDS**

#### **Introduction**

WIEB is considering a pilot test of a new tool (IRRIS, by GeoDecisions) for assessing route conditions along potential alternate nuclear waste shipment routes and for assessing state-local emergency response capabilities and needs. Many have called for route assessments that are detailed, “featured,” updatable, and packaged for effective use by state and local agencies for emergency response planning, assessing emergency response training and equipment needs, and evaluating routing options.

Despite the calls, such information has been produced only ad hoc, and for limited segments of selected routes. The major, very practical reason is that, using current methods, the development and maintenance of such information over thousands of miles of rail and highway routes crossing many states and local jurisdictions are daunting tasks—far exceeding current agency resources or prospective federal funds. Even if such information were available, there is no capability for distributing it in useful formats to those that have specific responsibilities along specific segments of a regional or national system.

Emerging tools offer the prospect of much more efficient and consistent assembly and maintenance of such information, and much more flexible, task-relevant distribution to those with particular responsibilities along particular route segments. The proposed pilot would evaluate the application of an emerging GIS-based tool (IRRIS) for these purposes. If states conclude that the results are promising, steps toward fuller development and distribution would be considered. The pilot phase would extend over the next 12 months.

#### **Pilot Study: Summary**

**What:** Obtain access to an emerging information management tool (IRRIS) to test it’s application and usefulness in evaluating conditions and affected environments along routes that might be used for SNF shipments.

**Where:** A route or set of routes will be selected for evaluating IRRIS application and usefulness. (This does not constitute selection of routes for SNF shipments, but rather an identification of generally available routes for the purpose of seeing how effectively IRRIS depicts various conditions of the route and its affected environment, and whether it may be useful too for discriminating among routes at some future time.)

**When:** The pilot project would begin in May, using FY 2008 WIEB funds that cannot be carried forward into FY 09. The project will likely extend into the 2009 fiscal year, but FY’09 expenditure will be limited.

**How:** WIEB will purchase a subscription for IRRIS from GeoDecisions for the purpose of the pilot evaluation. WIEB will contract with a GIS expert who develop a strategy for the evaluation and test, invite interested committee members to participate and advise in

process, and test the utility of IRRIS (current status and evolved) in “populating” templates intended for particular types of users and particular purposes regarding particular route segments. Templates will combine information on route conditions and environments (“features,” capabilities) relevant to particular planning or operations tasks. With consultant support, WIEB will compile a report that (a) assesses the utility of IRRIS as a tool for evaluating conditions important for SNF shipments along routes and (b) assesses the utility of IRRIS as a tool for discriminating among routes based on important conditions.

Products Anticipated products include:

- a) Sample templates: template concepts and rationale; and IRRIS test results;
- b) Data adequacy findings (vis-à-vis intended state-local purposes); data improvement suggestions.
- c) Next steps: to improve the data, the templates, &/or template distribution & application;
- d) Next steps: to develop and extend the application, if warranted.

### **Background**

The following provides additional detail on:

- Calls for detailed, “featured” assessment of route conditions, vulnerabilities, capabilities and needs.
- The question: If we are serious, how might it be done?
- Targeted information: a preliminary list
- Pilot study: tasks and approach

#### **1. Detailed & Integrated Route Information Needed**

Calls for more detailed, “featured” route information have come from several sources:

- **National Acad. of Science: “Going the Distance”**  
Undertake detailed surveys of routes to identify potential hazards.  
Take steps to avoid or mitigate such hazards through operational controls and restrictions
- **CA Energy Commission: “Nuclear Power in CA: 2007”**  
The probability of extreme accidents can be reduced through route-specific analyses to identify and diminish potential hazards. Greater information sharing by DOE regarding spent fuel transport routes and plans is needed to allow state and local input and to gain public confidence in these shipments.
- **DOE Repository SEIS: Affected Environment Related to Transportation...**  
An adequate description would include, not just estimated “populations,” but a systematic inventory of “features” (e.g. canyons and mountain passes, refineries and hazardous material industries, key infrastructure elements—e.g. bridges—and current conditions, hazardous materials flow, hospitals and nursing homes, stadiums and event centers, etc.), plus an inventory of state/local capabilities for addressing potential contingencies in various route segments. Some of these features and capabilities will be found beyond the half-mile buffer applied in the SEIS assessment. (WIEB comments.).

- **July 2007 Federal Register Notice on Section 180c:** Question 1(a): *Would \$200,000 be an appropriate amount for the assessment and planning grant to conduct an initial needs assessment...* States have varying planning and funding needs. (WIEB comment.)
- **December 2007 Federal Register Notice:** “Enhancing Rail Safety and Security for Hazardous Materials Shipments: Proposed Rule.” (DOT/PHMSA)  
The proposed rule requires rail carriers to: a) Compile annual data on specified shipments of hazardous materials; b) Use the data to analyze safety and security risks along transportation routes. c) Assess alternative routing options (based on risks assessed). d) Make routing decisions based on those assessments.

## 2. QUESTION: DO WE HAVE A CLUE HOW TO DO THIS?

- What do we mean by “detailed, featured” route-specific information?
- How can such be collected and maintained, efficiently and reliably? Over thousands of miles of highway and rail routes, crossing many jurisdiction and service area boundaries?
- Can such be assembled and delivered in forms useful to state-local agencies: e.g. task-specific; route segment-specific?

## 3. WIEB-DOE WORKPLAN: TASK #4. STATES’ CAPABILITIES & NEEDS

SRG staff will assist member states in conducting preliminary assessments of their capabilities and needs for assuring safe routine transport and safe and effective response to incidents involving SNF/HLW shipments. The capabilities and needs assessed could include those related to: emergency preparedness, emergency response, route assessment and designation, equipment, training, tracking, escorting and inspections, protection of information, and public information activities.

## 4. WHAT “DETAILED & INTEGRATED” INFORMATION IS TARGETED?

IRRIS “meta-data” will be reviewed to consider what is and is not included,<sup>53</sup> and to consider the sources, the level of detail, and reliability for intended purposes:

### Route assessment:

- a) Road conditions (physical infrastructure);
- b) Key features (bridges, tunnels, over & underpasses);
- c) Traffic volume (service levels);
- d) Truck traffic (& accident rate);
- e) Hazmat flow (reported at statistically appropriate level);
- f) Safe parking & safe havens;

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<sup>53</sup> **Shipment Information** (maybe second phase): a) Origin & destination; b) Near-site options (if applicable): barge, heavy-haul, shortline rail; c) Intermodal facility (if applicable); d) Cross-country mode: e.g. overweight truck; dedicated train; e) Route.....As designated from other processes; f) Operations agreements; g) Number & general schedule of shipment; h) Escort (& capabilities/roles); i) Inspections (& reciprocity agreements); j) Tracking/monitoring equipment/info sharing; k) Rolling stock (& shipment speed vs. other traffic).

- g) Weather patterns (e.g. days closed due to snow/ice);
- h) Local events that spike traffic volumes.

**Route environment:**

- a) Distance from roadway (residential; commercial);
- b) Density of development (residential & commercial, in bands);
- c) Hazardous activities (e.g. refineries, etc.);
- d) Vulnerable activities (e.g. hospitals, nursing homes, schools, etc.)

**State/local capabilities:**

- a) Fire & EMS (facilities; staffing; training level & status; access to route);
- b) Police/security (same);
- c) Radiological Specialist Capabilities;
- d) Command & control (plans, capabilities to implement plans).

**5. WIEB PILOT STUDY: FY'08 & FY'09**

Tasks include:

- Arrangements with GeoDecisions; Sub-contract for technical support
- Add selected data not now included in IRRIS
- Identify routes for pilot assessment (SNF transfer? Additional WIPP routes?)
- Form an advisory/review committee to provide feedback/guidance during the pilot.
- Obtain and review IRRIS data dictionary
- Considering potential state/local applications, prepare “pilot” information templates
- “Populate” the templates (using available data)
- Review results with the A/R Committee
- Identify steps to improve the templates: a) more useful for particular applications, b) more detailed/reliable/current data; c) more efficient/effective data assembly processes.
- Identify “next steps” and funding.

**Appendix B: HM-164 and Transportation Risk Assessment (See also: References)**

The current regulatory framework for selecting routes for HLRW is codified in 49 CFR 173.22. The implementation of the regulations is found in the Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantity Shipments of Radioactive Materials (referred to as the Guidelines). The Guidelines do not describe a procedure for a quantitative risk assessment; rather it is a method for producing a “risk index” for a particular route. The risk index number can then be used to compare alternative routes. (Rhyne 1994)The Guidelines also do not specify how to make a decision using the risk index.

The process specified in the Guidelines is

By comparison

Steps in the analysis procedure

1.2 Preliminary hazards analysis: define objectives scope

### 1.2.1 Define objective

- 1) Why is this being done
- 2) To estimate bounding or worst case consequence with or without a frequency estimate-any frequency estimate is likely to be qualitative
- 3) To assist with emergency planning
- 4) To meet regulatory requirements
- 5) To estimate corporate risk
- 6) To evaluate a range of risk reduction options
- 7) To evaluate a narrow set of risk reduction options

There are three dimensions to an analysis 1) the level of the scenario used 2) the desired level of frequency quantification 3) the desired level of consequence quantification

### 1.2.1.2 Identify hazards

### 1.2.1.3 Determine consequences of interest

### 1.2.1.4 Identify initiating events

## 1.2.2 Accident scenario development

## 1.2.3 Frequency Analysis

## 1.2.4 Consequence analysis

## 1.2.5 Risk Evaluation and presentation

“The transport system is not as well defined as a chemical plant. “

The transportation system definition is poor and therefore the system is not so clear as with a chemical plant. This lack of definition is approached by simplifying accident forces: often fire, puncture, impact and crush.

An important limitation of QRA is that it cannot guarantee that all accident initiators or accident scenarios have been identified.

Whitaker believes the record of predicting failure is not good. (Whitaker 1991)

A recent conference on the dangers of transporting hazardous materials the conferees could not agree on the solution of a benchmark problem. (Saccomano, Yu et al. 1993)

Normal radiation exposure

The fundamental task in route assessment is to determine which route minimizes radiological risk. The first step in calculating this is by calculating normal dose. This is calculated by:

Normal radiation dose D =	Dose to persons residing along + routes: D <sub>1</sub>	+ ing: Dose to passengers in + other vehicles: D <sub>2</sub>	Dose to truck Crew: D <sub>3</sub>	Dose to people at truck Stops: D <sub>4</sub>
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$$D = \left(\frac{PL}{V}\right) * C_1 + \left(\frac{LT}{V^2}\right) * C_2 + \left(\frac{LT^2}{V^3}\right) * C_3 + \frac{L}{V}$$

Where:

D= Normal radiation exposure comparison factor

P= Average population density along the route or route segment (people per mi<sup>2</sup>)

L=length of route segment (mile)

V=average speed of vehicles on the route or route segment (miles per hour)

C<sub>1</sub>=a constant: 6.8\*10<sup>-5</sup>

T= average traffic count on the route (vehicles per hour)

C<sub>2</sub>= Conversion factor

C<sub>3</sub>= Conversion factor

## Appendix C: Glossary

**Hazard:** the inherent characteristic of a material, condition, or activity that has the potential to cause harm to people, property or the environment.

**Risk:** the combination of the likelihood and the consequence of a specified hazard being realized.

Frequency is the rate at which events occur and may be expressed as events/year, accidents/mile, etc...

The frequency component normally consists of the frequency multiplied by several conditional probabilities.

Probability is a number between one and zero that expresses a degree of belief concerning the possible occurrence of an event.

Consequence is the direct result of the accident or incident.

An absolute QRA incorporates quantitative estimates of both frequency and consequences- a disadvantage of this technique is that certainty about the accuracy of the results is impossible P 2. Also, there are no standards for risk acceptability.

A relative risk analysis means that risk is evaluated in comparison with another risk: the comparison can be quantitative or qualitative.

Risk analysis is the computation of risks and risk assessment is the determination of risk acceptability. Taking action to reduce risks is risk management.

An initiating event is the first in a sequence of events that may lead to an undesirable consequence.

## Appendix D: Sources Consulted

Code of Federal Regulations 49 Part 177.825 Code of Federal Regulations 49 Part 177.825. Washington D.C.

Dilger, F. and R. Halstead (2003). Many Roads to Travel: Alternative Approaches to Route Selection for Yucca Mountain Shipments. Waste Management 2003, Tucson AZ.

Federal Geographic Data Committee. (2008). "The Federal Geographic Data Committee." 2008.

MRW & Associates, I. (2007). Nuclear Power in California: 2007 Status Report. C. E. Commission. Oakland, CA.

National Research Council (2006). Going the Distance? The Safe Transport of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States. Washington, D.C. , National Research Council.

Pipeline and Hazardous Materials Safety Administration (2008). Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments; Railroad Safety Enforcement Procedures; Interim Final Rule and Proposed Rule. D. o. Transportation. Washington D.C. . **49 CFR Parts 172, 174, and 209**.

Rhyne, W. R. (1994). Hazardous Materials Transportation Risk Analysis. New York, Van Nostrand Reinhold.

Saccomano, F. F., M. Yu, et al. (1993). "Risk uncertainty in the transport of hazardous materials." Transportation Research Record **1383**: 58-66.

US Department of Transportation (1992). Guidelines for Selecting Preferred Highway Routes for Highway Route Controlled Quantity Shipments of Radioactive Materials. Washington, D.C., US Department of Transportation.

Whitaker, J. (1991). "A reappraisal of quantitative risk analysis." Engineering Manufacturing Journal **3(3)**: 13-16.

## Appendix E: References and Resources

### 1. The National Hazardous Materials Route Registry: Federal Motor Carrier Safety Administration

The NHMRR is the national repository of both non-radioactive hazardous materials (NRHM) and Radioactive (RAM) routes which are either designated for the hazmat transportation or restricted from use by hazmat carriers. The primary means of identifying and storing a particular route in the registry is through a textual description of the route which is stored in a database. This information was collected from each State, Territory, and Indian Tribe that has assigned a routing agency. A routing agency is designated by the Governor or Indian Tribe official and is responsible to supervise, coordinate, and approve all NRHM routing designations and restrictions prescribed by state, county, local or other governing body within the State, Territory, or Indian Tribe lands. Presently, there are still a few States, Territories, and Indian Tribes that have not yet assigned a routing agency; therefore, reporting for these entities is not complete.

Each route description within the registry contains the street, highway, bridge, or tunnel upon which the route is based and may contain two intersecting streets or highways (terminators) that define the starting and ending points of the route along the route. The route description may also include descriptors and notes [found within brackets] which will further describe the route or the intersecting roads which define it. The description will contain the route origination date, the date in which the route first went into effect, and the last update date, the date in which changes to the route were last logged in the route registry database. The last update date currently does not appear in the web route report output; however, you can select records on the query form based on this data field. This is useful to find routes that have been updated or changed in the registry since a particular date.

The route description will also include tags that identify what type of material is designated for transportation or restricted from use on the route. These tags can be decoded using the following Restriction/Designation key.

<http://hazmat.fmcsa.dot.gov/nhmrr/index.asp>

### 2. Guidelines for Selecting Preferred Highway Route Controlled Quantity Shipments of Radioactive Materials (RSPA-HMS-92-02)

A comprehensive 109 page document has been compiled which describes in technical detail the federal guidelines for selecting highway route controlled quantities (HRCQ) of radioactive materials. This document was authored by the Research and Special Programs Administration (RSPA) and describes the quantitative techniques to be employed to calculate a risk assessment of a proposed or existing radioactive material (RAM) route to determine its compliance. These techniques factor in radioactive dispersion, weather, population density, type of highway, emergency response capabilities, terrain/environmental factors, accident statistics, and other parameters.

<http://hazmat.fmcsa.dot.gov/nhmrr/PDFs/ramguide.pdf>

### **3. Guidelines for Applying Criteria to Designate Hazmat Routes (FHWA-SA-94-083)**

A comprehensive 131 page document has been compiled which describes in technical detail the federal guidelines which States, Territories, and Indian Tribes must follow when designating non-radioactive hazardous material (NRHM) routes. This document was authored by the Federal Highway Administration (FHWA) and describes the quantitative techniques to be employed to calculate a risk assessment of a proposed or existing hazardous material route to determine its compliance. These techniques factor in population density, type of highway, emergency response capabilities, terrain/environmental factors, accident statistics, and other parameters. This guide was revised in 1996 by the National Highway Institute by the document entitled "Highway Routing of Hazardous Materials: Guidelines for Applying Criteria" FHWA-HI-97-004, NHI Course No. 38064.

<http://hazmat.fmcsa.dot.gov/nhmrr/PDFs/nrhmguid.pdf>

### **4. PHMSA-RSPA-2004-18730: Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments; Interim Final rule; Published 4/16/2008; Effective Date 6/1/2008; 73 FR 20751.**

SUMMARY: The Pipeline and Hazardous Materials Safety Administration, in coordination with the Federal Railroad Administration and the Transportation Security Administration, is revising the current requirements in the Hazardous Materials Regulations applicable to the safe and secure transportation of hazardous materials transported in commerce by rail. This interim final rule fulfills requirements in Section 1551 of the Implementing Recommendations of the 9/11 Commission Act of 2007.

This rulemaking was formerly designated as HM-232E; however, with the transition to a new government-wide regulations portal, docket number nomenclature has since changed. Some references to the old docket number are still present in this document.

In this interim final rule, we are requiring rail carriers to compile annual data on certain shipments of explosive, toxic by inhalation, and radioactive materials, use the data to analyze safety and security risks along rail routes where those materials are transported, assess alternative routing options, and make routing decisions based on those assessments. We are also clarifying rail carriers' responsibility to address in their security plans issues related to en route storage and delays in transit. In addition, we are adopting a new requirement for rail carriers to inspect placarded hazardous materials rail cars for signs of tampering or suspicious items, including improvised explosive devices.

<http://hazmat.dot.gov/regs/rules/final/73fr/docs/73fr-20751.pdf>

**5. Federal Railroad Administration: Background Report on the PHMSA Interim Final Rule**

<http://www.fra.dot.gov/downloads/PubAffairs/RailHazmatRoutingIFRBackgrounder041608.pdf>

**6. DARPA Overview: Bridging the Gap, Feb. 2007**

DOD: Defense Advanced Research Projects Agency (DARPA)

<http://www.darpa.mil/body/pdf/DARPA2007StrategicPlanfinalMarch14.pdf>

**7. DOE Transportation Emergency Preparedness Program: TEPP**

Model Need Assessment: Self Assessment Document (Rev 6-08/2007)

[http://www.em.doe.gov/PDFs/TEPP/2-a%20Model\\_Needs\\_Assessment.pdf](http://www.em.doe.gov/PDFs/TEPP/2-a%20Model_Needs_Assessment.pdf)

**8. Hazard Prediction and Assessment Capability: Fact Sheet, July 7, 2007**

DOD Defense Threat Reduction Agency (DTRA)

[http://www.dtra.mil/newsservices/fact\\_sheets/fs\\_includes/pdf/Hazard\\_Prediction\\_and\\_Assessment\\_Capability.pdf](http://www.dtra.mil/newsservices/fact_sheets/fs_includes/pdf/Hazard_Prediction_and_Assessment_Capability.pdf)