SUMMARY OF ACCOMPLISHMENTS OF JOINT RUSSIAN-AMERICAN TOMSK MODELING WORKSHOP

17 to 20 March 1997

Pacific Northwest National Laboratory, Richland, Washington, USA

ATTENDERS
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BACKGROUND
A cooperative Russian-American study was begun in January 1997 to develop joint models of the Tomsk Site injection areas to compare the approaches, assumptions, and results. Initial work was the compilation of bounding geologic geometry of the injection zone by the Russian members of the team. The purpose of this March 1997 workshop was to compare and evaluate PNNL's digital versions of the maps received from our Russian counterparts, and to coordinate and develop an outline for future modeling of the Tomsk Site.

ACCOMPLISHMENTS
• We compared PNNL's digitized versions of the four 1:50,000-scale topographic maps provided by VNIIPIT with the raw contour data and examined their edge-matching with contours derived from previously obtained military topographic maps of areas to the east and south:
  – Minor differences in contour matches at the edges of maps were judged insignificant, and will be averaged out
  – Well G-17 is shown in a different place on the new VNIIPIT maps compared with maps in the 1994 injection book; Kurochkin will find the source of this difference upon his return to Moscow
• We developed a modeling strategy encompassing current site-characterization work and outlining subsequent modeling and field-validation studies and their relations to DOE and MINATOM needs (see Attachment I).
• We developed a brief Statement of Work for VNIIPIT site-characterization activities for the remainder of FY 1997 (see Attachment II).
• PNNL received the electronic version (Word 6.0) of the revised injection book (English translation), and we discussed:
  – The quality of the translation, which somewhat oversimplifies the original Russian technical discussion
  – The transmittal by VNIIPIT to PNNL of originals of the figures
  – The potential for publication by Battelle Press after the translation and figures are complete
• We discussed past communication difficulties, and agreed that future technical communications should be directly between VNIIPIT and PNNL
JOINT U.S.-RUSSIAN CONTAMINANT-MIGRATION EXPERIMENT AT TOMSK

OBJECTIVES

In support of JCCEM Contaminant Migration studies, we will use the Russian’s 40 years of experience with deep-well injection of liquid radioactive waste at Tomsk to evaluate and improve DOE's technology for site characterization and predictive modeling of radionuclides in ground water.

SCOPE:

- We will use existing and specially gathered Tomsk site characterization data to develop the hydrogeologic framework in which contaminant migration occurs (FY-96 to FY-98).
- We will use historical Tomsk well-injection data and monitoring well measurements of migration over succeeding decades to develop the geochemical basis and models of contaminant migration in the ground water (FY-99 to FY-00).
- We will use these models to make predictions of contaminant migration Tomsk, which we will then test with contaminant data from new wells drilled for the purpose (FY-00 to FY-01). This task and the previous one will result in improvements to current DOE modeling capabilities.

BENEFIT TO DOE

The expected outcome of this work is the comparison of results of U.S. and Russian models of the migration of radioactive injection plumes with contaminant-plume data (collected from one or more new wells drilled especially for this purpose) at Tomsk for which 40 years of data are available. From this comparison of two efforts conducted at different levels of detail over different areas, expected benefits to DOE are to:

- Learn more about site characterization--
  - Are we using the most efficient methods (are there Russian approaches that are better/faster/cheaper)?
  - Are we using the most up-to-date techniques (do the Russians have new/innovative approaches not in use in the U.S.)?
  - Is there more information to be gleaned from the methods we are currently using (do the Russians use the same methods, but gain additional data)?
  - How much is good enough (what level of detail and what regional extent is necessary)?
- Improve our understanding of various waste-disposal practices
- Learn more about full-scale contaminant migration
- Benchmark DOE models used to predict contaminant migration, how good those predictions are, and how models can be further improved

BENEFIT TO MINATOM

The cooperative work program on analysis of contaminant migration at the Tomsk site is of interest to the Russian side (MINATOM) for the following reasons:

- Provide peer review of the environmental impact of injection of liquid radioactive waste as a waste-management method
- Perform exchange of information on the computer programs being used for modeling (by both sides) of the migration of contaminants
- Evaluate performance of joint forecasts/predictions of contaminant migration
- Provide for participation by the U.S. in the program of experimental drilling into the contaminant plume

**SPECIFIC ACTIVITIES**

As part of JCCEM activities in contaminant migration, PNNL, WSRC, and their Russian counterparts are working to incorporate Russian experience with liquid radioactive waste disposal and measurements of subsequent radionuclide migration to evaluate and improve DOE technology for predicting radionuclide migration at contaminated U.S. sites. PNNL has used an approach to site characterization and modeling of contaminated former nuclear production sites in the former Soviet Union that started with relatively low-resolution modeling of the regional hydrogeologic system using published and remotely sensed data. Results of this modeling provide the regional context for the more detailed models to be developed in this project to predict contaminant migration from historic injection of liquid radioactive wastes at the Tomsk Site and to test those predictions against new measurements of the Tomsk contaminant plumes.

**Detailed Site Characterization (FY 1996 - 1998)**

Data needed for detailed hydrogeologic and contaminant-transport modeling of the Tomsk Site by PNNL are similar to those used for the Russian's initial studies of the area and its potential for isolation of the injected plumes prior to selection of the injection areas. However, to fully evaluate existing DOE approaches to site characterization and modeling, PNNL must model a larger area in greater detail than used in previous Russian studies. The Russian side must therefore reevaluate existing data both to expand the area of coverage (including acquiring data from agencies working outside the usual area of Tomsk Site studies) and the detail of characterization of the area previously modeled. This work will be pursued in three parts:

1. Russian side will provide maps at 1:50,000 scale of topography (as needed for those areas not already in PNNL's database) and structural contours of the top of the Paleozoic basement rocks of the model area by the end of January 1997. PNNL will digitize these map data and add them to the joint U.S.-Russian GIS database. **STATUS-COMPLETED**

2. Russian side will provide 1:50,000-scale structure-contour maps of the tops of the Mesozoic transmissive horizons (I, II, and III) and confining layers (A, B, C, and D) by the end of September 1997. PNNL will subsequently digitize these data and add them to the joint U.S.-Russian GIS database. Data describing the hydrogeologic and hydrogeochemical properties of these layers will also be provided as they are acquired.

3. Russian side will provide 1:50,000-scale structure-contour maps of the tops of the Cenozoic transmissive horizons (IV, IVa, V, and VI) and confining layers (E, F, and G) by the end of September 1998. PNNL will subsequently digitize these data and add them to the joint U.S.-Russian GIS database. Data describing the hydrogeologic and hydrogeochemical properties of these layers will also be provided as they are acquired.


Using site characterization data and conceptual models developed jointly with their Russian counterparts, PNNL will develop and calibrate a detailed, three-dimensional regional hydrogeologic model of the Tomsk Site. This ground-water model will be the context in which PNNL and
the Russians jointly develop geochemical/contaminant-migration models of one or more of the radioactive-waste injection plumes at Tomsk. Historical data on pre- and post-injection aquifer properties, injection histories, and monitored plume concentrations will be used to develop a computer model of plume migration. Results of this model will be compared with those of earlier Russian models developed for initial injection-area evaluations and subsequent operations. Analysis of similarities and differences between model results will provide the basis both for evaluating the apparent accuracy/efficiency of model predictions in the context of their different areas of extent and levels of detail, and for selecting the location(s) of a new borehole(s) that will provide data to best evaluate the accuracies of the models.

**FIELD EVALUATION OF MODEL RESULTS (FY 2000 TO 2001)**

After completion of evaluation of results of Russian and U.S. predictive modeling, the accuracies of the predictions will be evaluated by drilling a new borehole to sample the chosen portion(s) of the contaminant plume. This effort will provide the basis for evaluating the effectiveness of different levels of site characterization detail and different combinations of model extent and detail.
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TECHNICAL TASK

The Russian site-characterization team will provide 1:50,000-scale structure-contour maps of the tops of the Mesozoic transmissive horizons (I, II, and III) and confining layers (A, B, C, and D) for a region to be defined jointly by the U.S. and Russian participants. PNNL will subsequently digitize these data and add them to the joint U.S.-Russian GIS database. Data describing the hydrogeologic and hydrogeochemical properties of these layers will also be provided to PNNL by the Russian site-characterization team as they are acquired.

SCOPE

Estimated FY 1997 cost for Russian characterization of the Mesozoic strata of the entire model area is $60,000. PNNL modeling team costs for FY 1997 participation are included in the current PNNL project scope.

DELIVERABLE

Russian side will provide 1:50,000-scale structure-contour maps of the tops of the Mesozoic transmissive horizons (I, II, and III) and confining layers (A, B, C, and D) by the end of September 1997.

PROJECT PARTICIPANTS ON THE RUSSIAN SIDE:

- VNIPPromtechnologii
- Other Russian organizations subcontracted to VNIPPromtechnologii

PROJECT PARTICIPANTS ON THE U.S. SIDE:

- Pacific Northwest National Laboratory (PNNL)