The Emissions Inventory Database Application Component of the Air Quality Management Decision Support System for Beijing

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Objective: Improve Air Quality

Two Views of Beijing

Photos by Robert Zerbonia, 2003

Overview

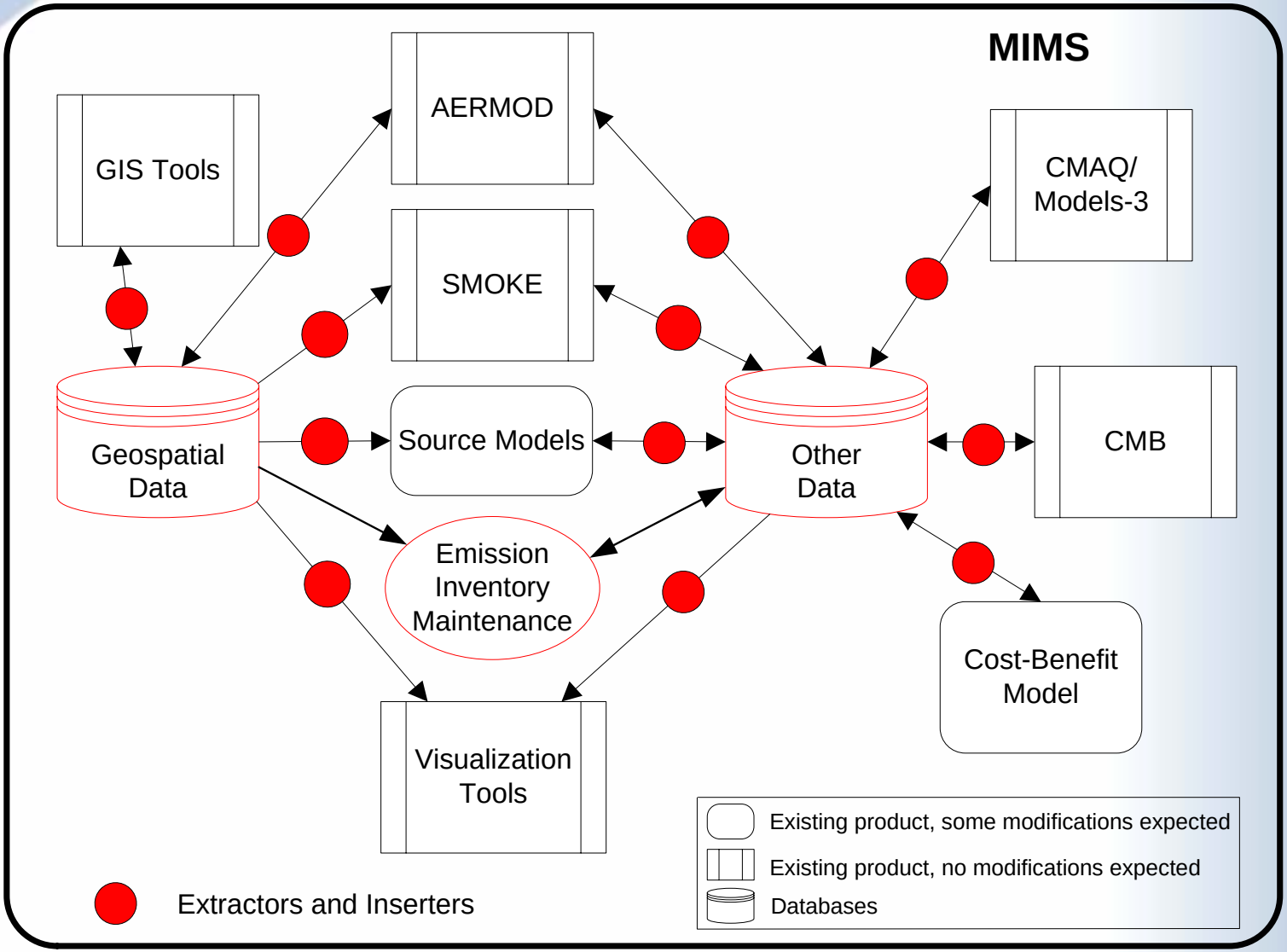
- Project overview
- AQMDSS architecture
- Database design
- Emission inventory application
- User interface
- Status

Project Overview

- Purpose is to create a decision support system for the Beijing Municipal Environmental Protection Bureau (BMEPB)
- Objectives of the AQMDSS:
  - Help BMEPB to understand the contributors to poor air quality
  - Provide source apportionment tools
  - Simulate control decisions
  - Produce next day air quality forecasts

International Team

- Project management
  - George Gao, PA Consulting
- AQMDSS design and implementation, arrange training
  - Robert A. Zerbonia, Jo Ellen Brandmeyer, Eric Solano, Mark Bruhn, Sunil Rao, and Aaron Parks, RTI International
- Translation, loading emissions inventory and other data sets, on-site GIS support, training
  - Institute of Atmospheric Physics, Beijing Institute of Surveying and Mapping, other research groups

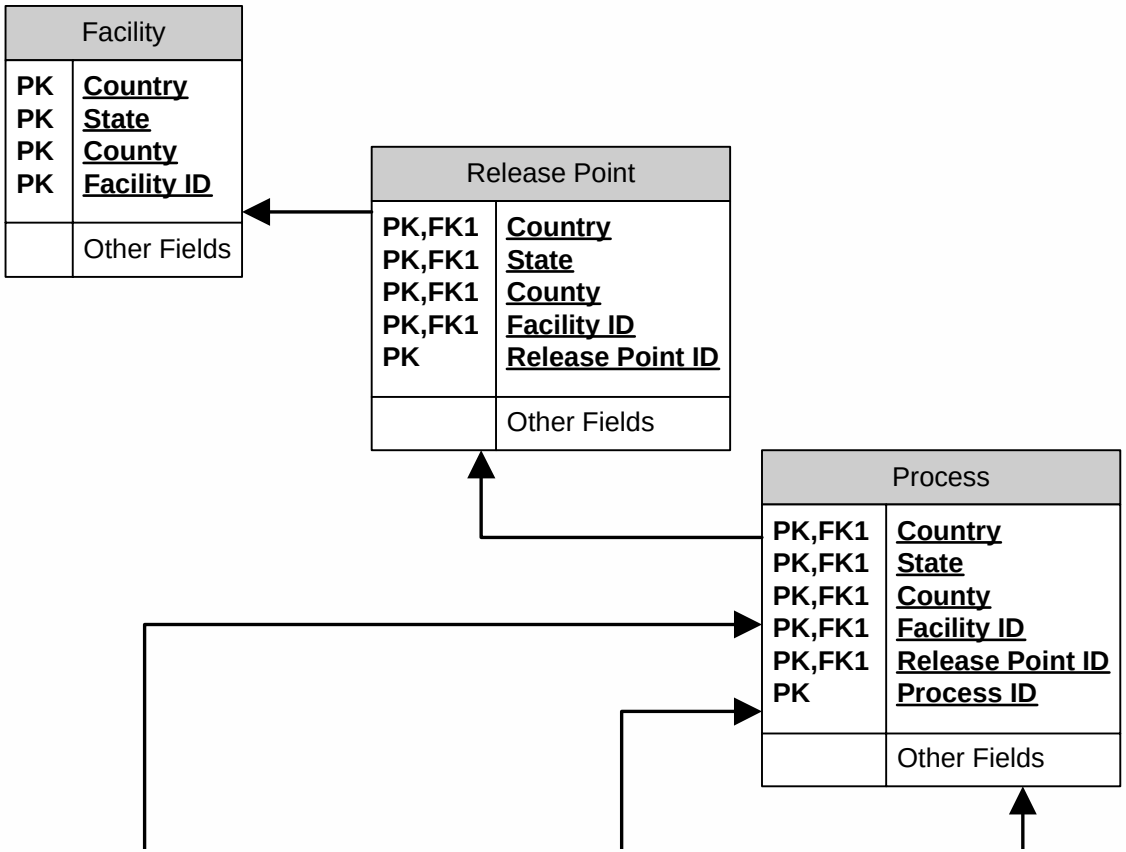

MIMS
AERMOD
GIS Tools
CMAQ/
Models-3
SMOKE
Geospatial
Data
Source Models
Other
Data
CMB
Emission
Inventory
Maintenance
Cost-Benefit
Model
Visualization
Tools
Existing product, some modifications expected
Existing product, no modifications expected
Databases
Extractors and Inserters

Connectivity

- No changes to models
- Extractors to read data from database
  - Extract data from database to file structure required by a model
  - Use parameter values from MIMS scenarios
  - Convert from metric system to units required by the models
- Inserters to write data to the database
  - User selects data to add to database for later analysis

Relational Database Design

- Referential integrity included within structure



QA Features Built In

- Codes maintained within database
  - Pollutants, equipment types, source category codes (SCC)
- Codes validated against lookup tables during data entry
  - Foreign key constraints
- Range constraints to reduce processing errors
  - Hours/day, weeks/year

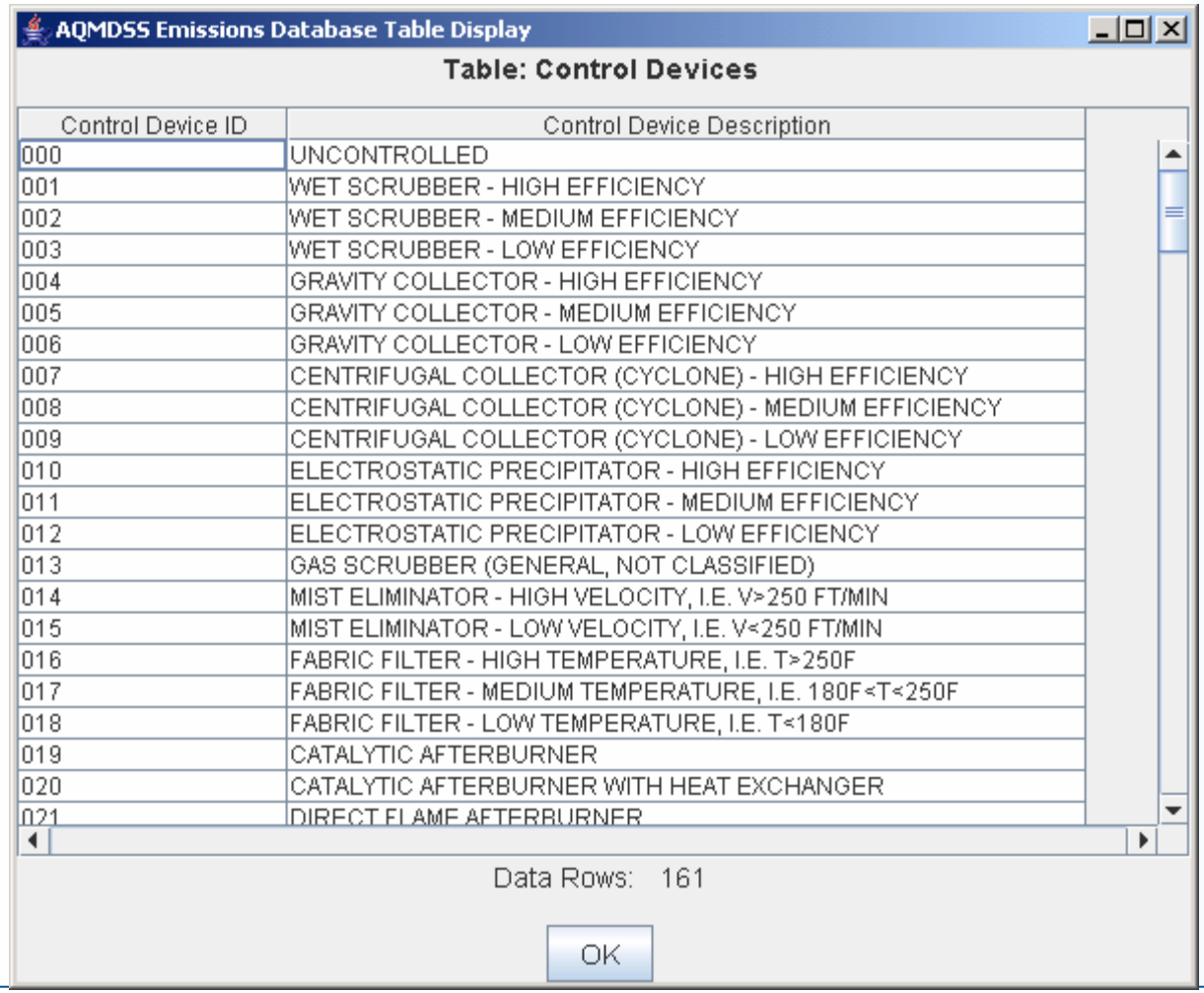
Extensible Design

- Based on National Emission Inventory Input Format version 3.0
  - Enhanced with country codes for continental inventories
- Additional tables and fields to support processors and models in the AQMDSS
  - Add new fields to existing tables
  - Add new, related tables
  - No effect on operation of existing processors
- Includes spatial data objects for mapping and spatial analyses

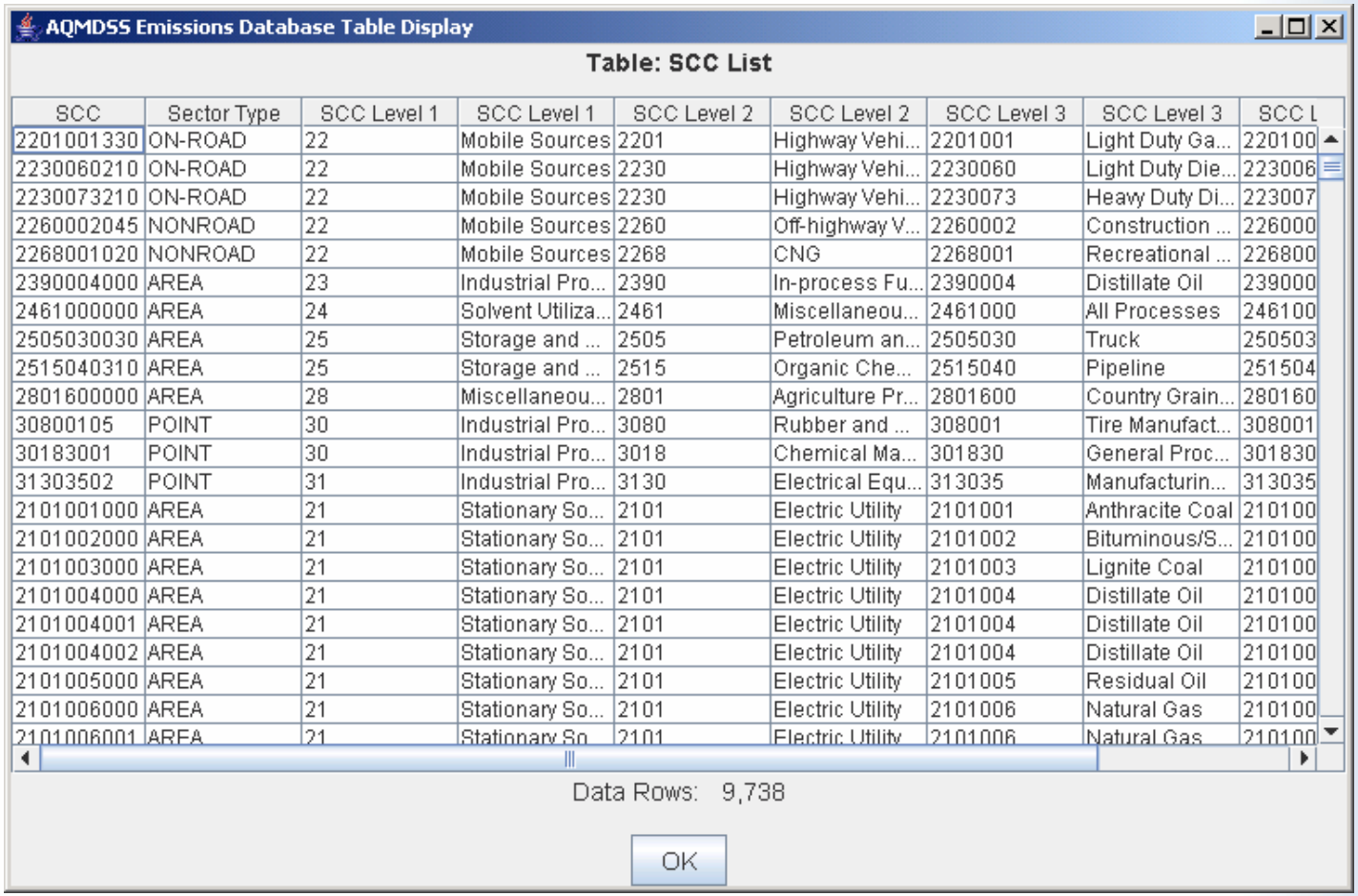
Emission Inventory Maintenance

- Designed to minimize data entry errors
  - Drop-down boxes and browsers for codes
  - Screens support referential integrity
    - Parent/child frames support parent/child relationships in database
  - Additional range-checking
- Structure driven by metadata in database
  - Add more tables and fields with no programming
- Supports multiple types of users

Example Simple Lookup Table

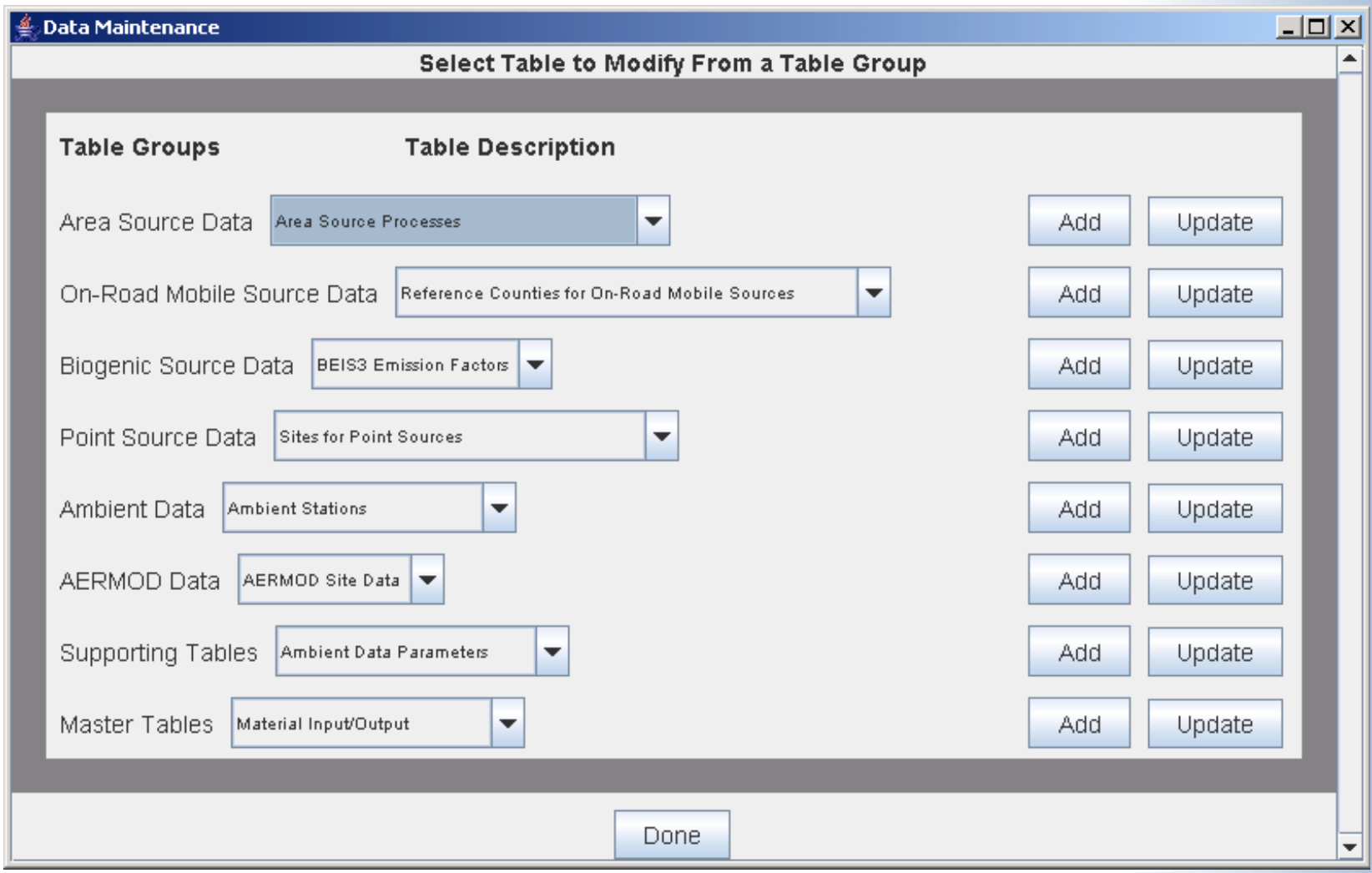


Example Multi-column Lookup Table

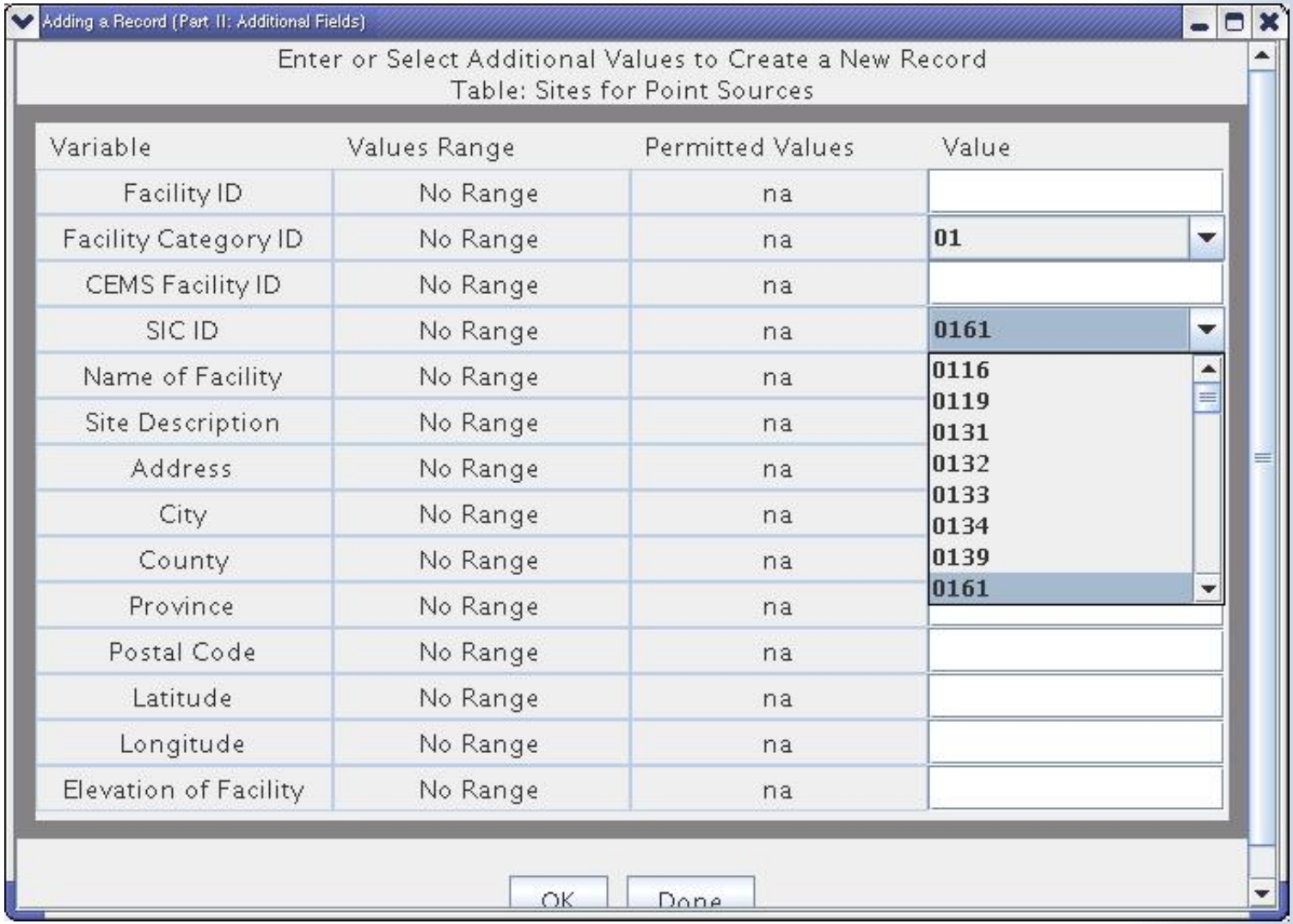


SCC	Sector Type	SCC Level 1	SCC Level 1	SCC Level 2	SCC Level 2	SCC Level 3	SCC Level 3	SCC L
2201001330	ON-ROAD	22	Mobile Sources	2201	Highway Vehi...	2201001	Light Duty Ga...	220100
2230060210	ON-ROAD	22	Mobile Sources	2230	Highway Vehi...	2230060	Light Duty Die...	223006
2230073210	ON-ROAD	22	Mobile Sources	2230	Highway Vehi...	2230073	Heavy Duty Di...	223007
2260002045	NONROAD	22	Mobile Sources	2260	Off-highway V...	2260002	Construction ...	226000
2268001020	NONROAD	22	Mobile Sources	2268	CNG	2268001	Recreational ...	226800
2390004000	AREA	23	Industrial Pro...	2390	In-process Fu...	2390004	Distillate Oil	239000
2461000000	AREA	24	Solvent Utiliza...	2461	Miscellaneou...	2461000	All Processes	246100
2505030030	AREA	25	Storage and ...	2505	Petroleum an...	2505030	Truck	250503
2515040310	AREA	25	Storage and ...	2515	Organic Che...	2515040	Pipeline	251504
2801600000	AREA	28	Miscellaneou...	2801	Agriculture Pr...	2801600	Country Grain...	280160
30800105	POINT	30	Industrial Pro...	3080	Rubber and ...	308001	Tire Manufact...	308001
30183001	POINT	30	Industrial Pro...	3018	Chemical Ma...	301830	General Proc...	301830
31303502	POINT	31	Industrial Pro...	3130	Electrical Equ...	313035	Manufacturin...	313035
2101001000	AREA	21	Stationary So...	2101	Electric Utility	2101001	Anthracite Coal	210100
2101002000	AREA	21	Stationary So...	2101	Electric Utility	2101002	Bituminous/S...	210100
2101003000	AREA	21	Stationary So...	2101	Electric Utility	2101003	Lignite Coal	210100
2101004000	AREA	21	Stationary So...	2101	Electric Utility	2101004	Distillate Oil	210100
2101004001	AREA	21	Stationary So...	2101	Electric Utility	2101004	Distillate Oil	210100
2101004002	AREA	21	Stationary So...	2101	Electric Utility	2101004	Distillate Oil	210100
2101005000	AREA	21	Stationary So...	2101	Electric Utility	2101005	Residual Oil	210100
2101006000	AREA	21	Stationary So...	2101	Electric Utility	2101006	Natural Gas	210100
2101006001	AREA	21	Stationary So...	2101	Electric Utility	2101006	Natural Gas	210100

Example Data Entry Menu



Example Data Entry Screen



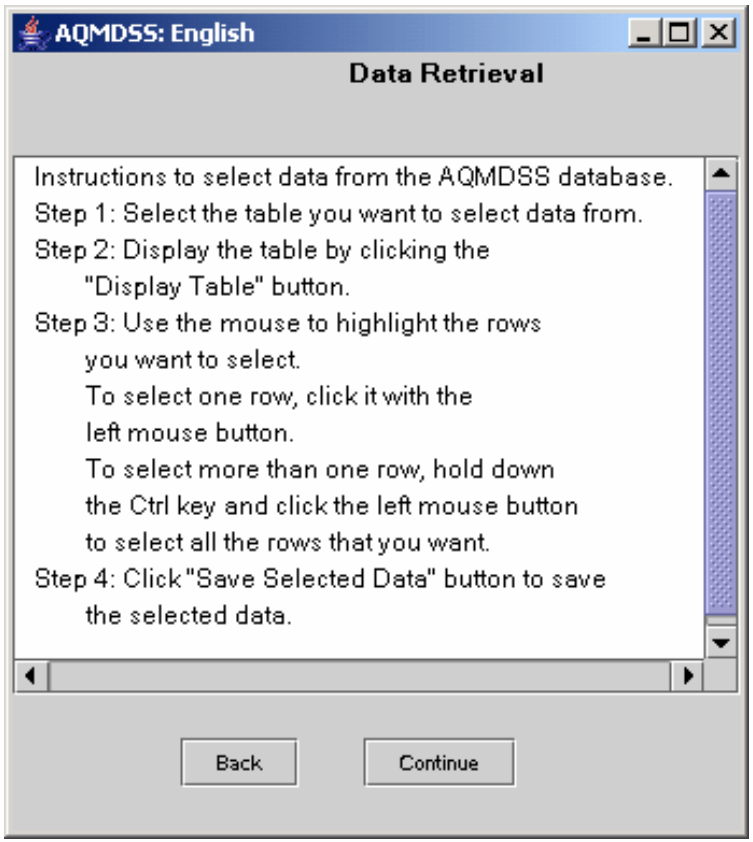
Internationalized User Interface

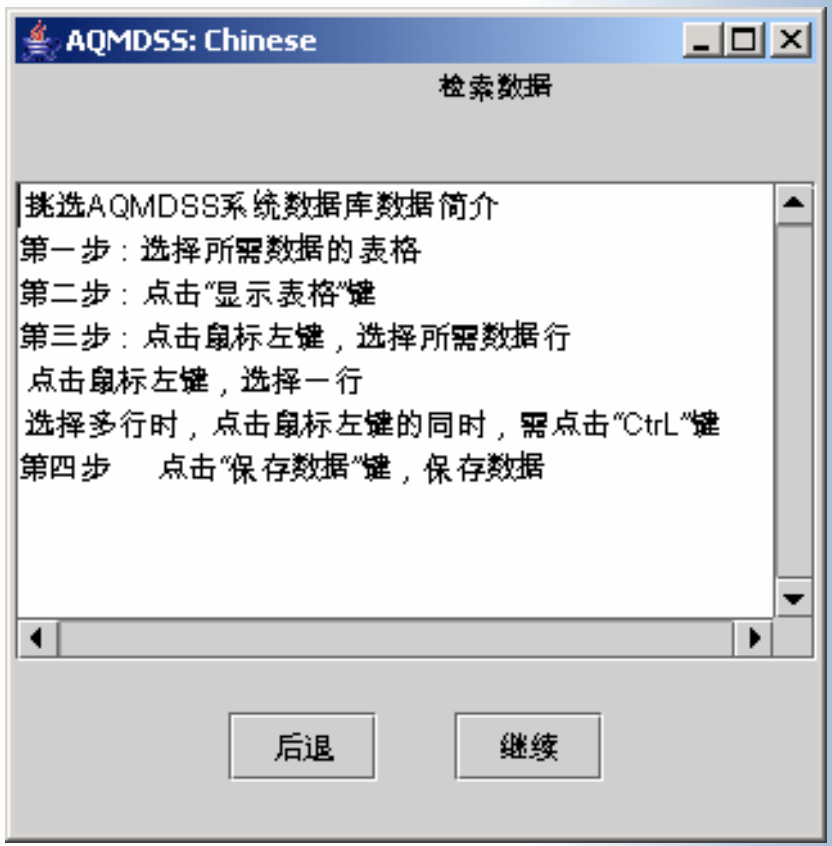
- Data entry screens and messages to user
  - Program looks up strings to display
- All strings are in text files
  - Simplifies translation and maintenance
- Providing AQMDSS using both Chinese and English strings
  - Easily translatable to other languages (e.g., Spanish)
  - Default is English for any string not found in target language

Find a String to Display

- Hierarchy using **locale** of current user
  - Language, Country, System
  - Language, Country
  - Language
  - Default
- Hierarchical search for each string
  - Reduce changes between countries for same language

Internationalization Example





Status

- Design Report – complete and accepted
- Implementation – in progress
- Testing with test data – this summer
- Delivery to consultants in Beijing to load real data
- Final testing in Beijing
- Target delivery date to BMEPB – December 2005
- Final report – April 2006

Questions?