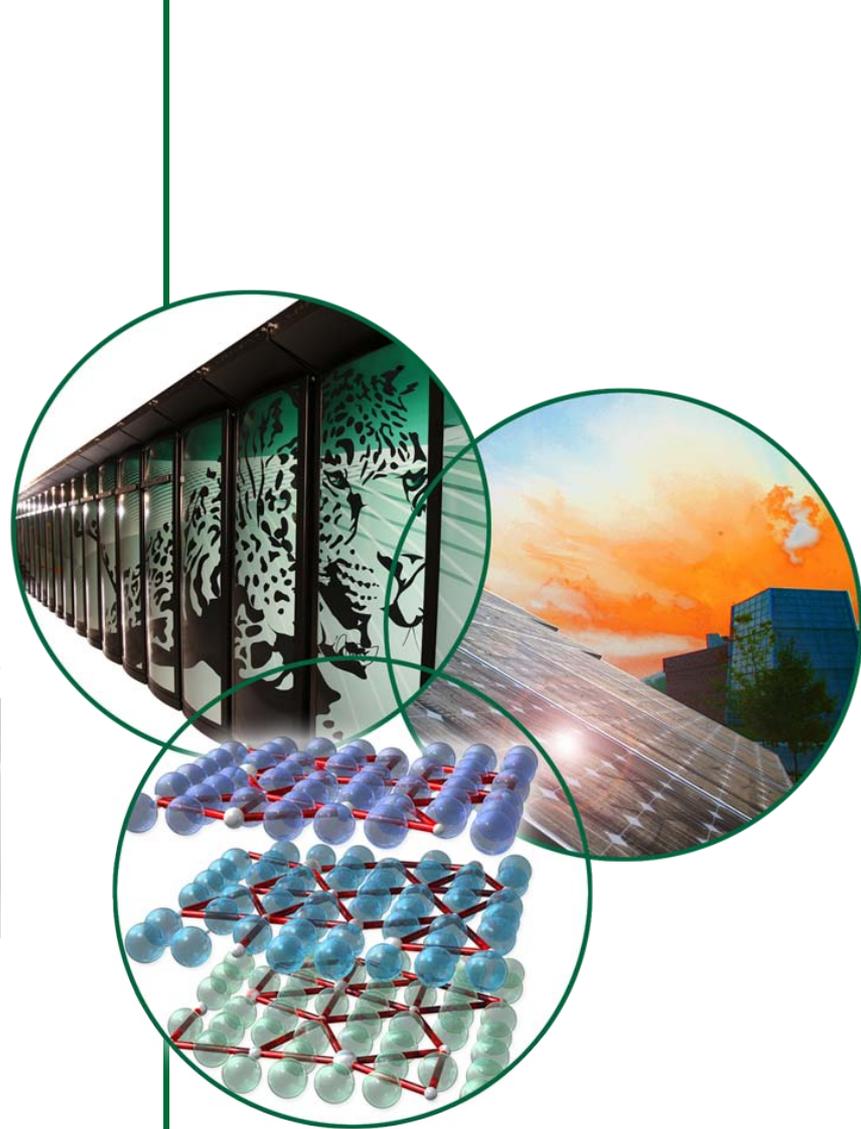


Campus Information Modeling at ORNL



Damen Belcher, CEM, ASQ SSGB
Oak Ridge National Laboratory
Facilities Development Division



Campus Information Modeling at ORNL

- ORNL Facilities Development Division Overview
- CIM Overview
- Integrated Campus Information
 - GeoSpatial Indexing
 - BIM / CAD / GIS / Integration
 - Utility Information Integration
 - Automated PDF Distribution
 - Facility Information Center
- Campus Information Modeling Tools in Development
 - Maintenance Management
 - Excavation / Penetration Permitting

ORNL is DOE's largest multipurpose science laboratory

- \$1.04 billion budget
- 4,000 employees
- 3,000 research guests annually
- Nation's largest unclassified scientific computing facility

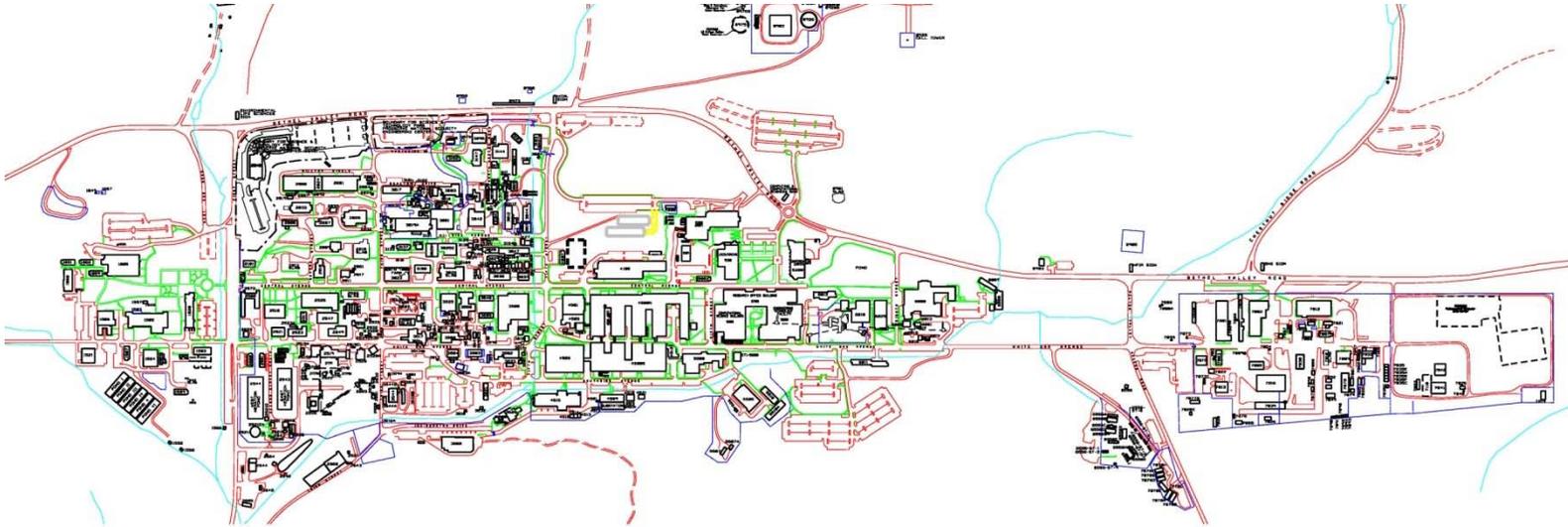
- Established 1943 for the Manhattan Project
- Covers 58 square miles
- Current replacement cost of facilities: \$7 Billion
- Nation's largest science facility: the \$1.4 billion Spallation Neutron Source
- Nation's largest concentration of open source materials research
- Nation's largest energy laboratory
- \$300 million modernization

Nation's largest unclassified scientific computing center.



Facilities Development Division

- **Modernizing ORNL with Infrastructure to Support World-Class Science**
- **Engineering Design, Project Management, and Construction Management**
 - **New facilities, Facility modifications, and Demolition**
 - **Infrastructure**



Example of FDD's mission:

ORNL East Campus – March 2002



ORNL EAST CAMPUS TODAY
A LEED CAMPUS, the first for DOE and Tennessee!



ORNL's Information Integration Challenges

- **Legacy Information**

- Wealth of existing information about ORNL Facilities
 - Dates back to Manhattan Project
 - Generally “unintelligent” hard copy format
 - Variety of information tracking methods used over the years

- **New Information**

- Constantly generating new information about ORNL Facilities
 - Data is more “intelligent”
 - Various electronic file formats

Information Management Goal

- Integrate new and legacy information in a way that maximizes information access, security, reliability, and application.



Campus Information Modeling

- What is CIM?
 - Not Building Information Modeling (BIM)
 - Not specifically focused on single phase of facility life cycle (i.e. design, construction, operation, etc.)
 - Sustainability in Information Management



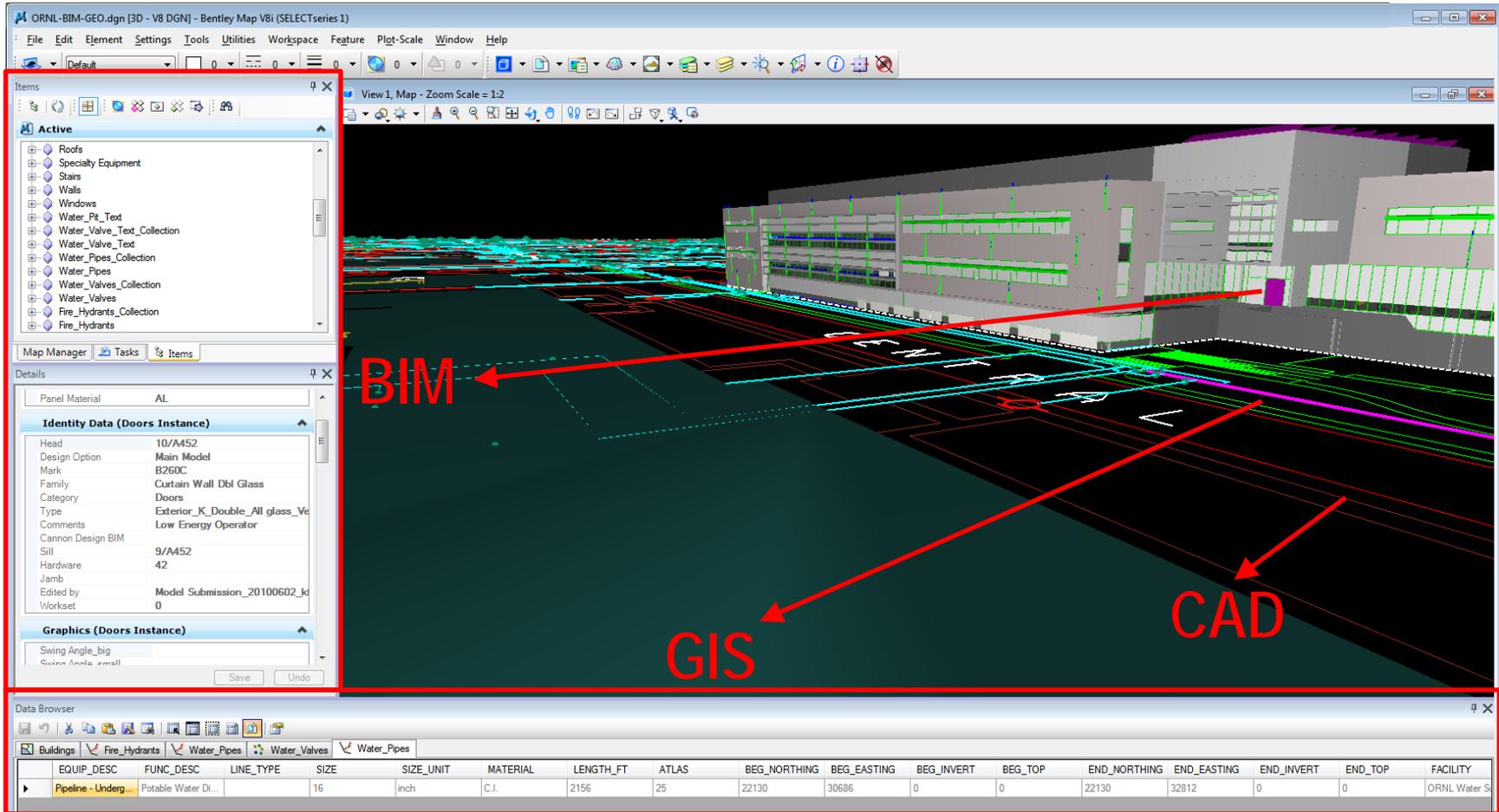
Campus Information Modeling Methodology

- Make the best of what you have.



Campus Information Modeling

- What does it look like?
 - BIM / CAD / GIS (*Utility*) Integration



Industry Collaboration

- Sandia National Laboratory
- Bentley Systems, Inc.
- Tennessee Department of Transportation
- US Army Corps of Engineers
- US Air Force
- Architect / Engineering Firms

Internal ORNL Collaboration

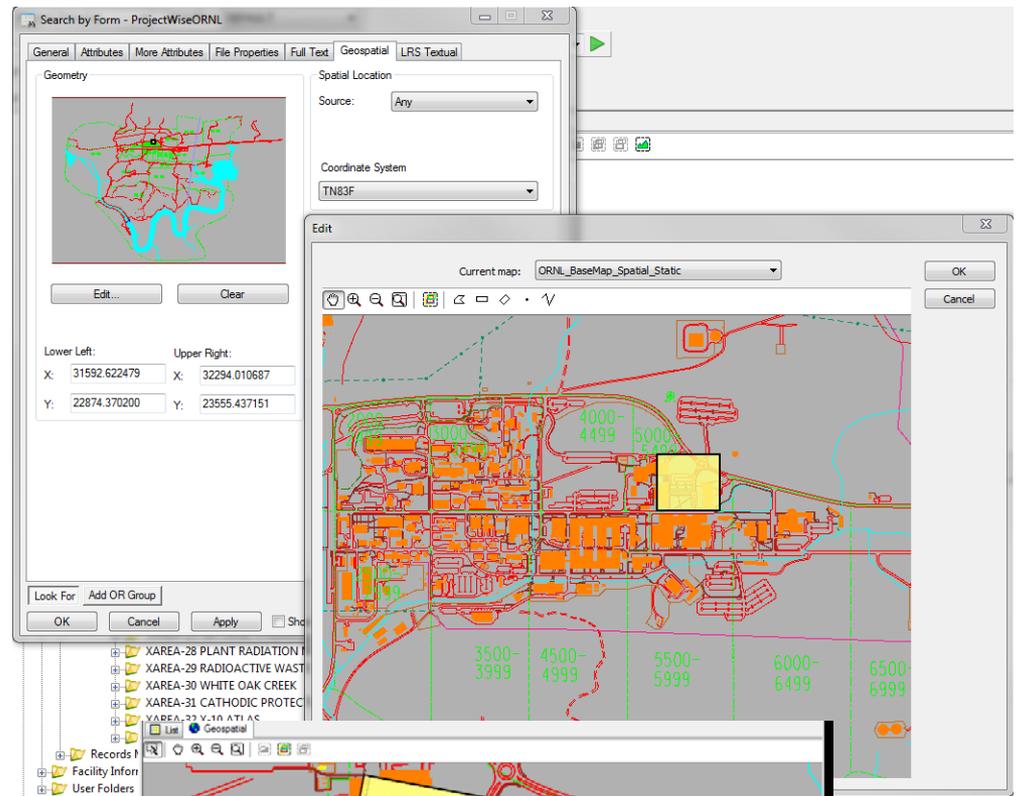
- Integrated Operations Support Division
- Information Technology Services Division
- Facility Management Division

Campus Information Modeling Tools

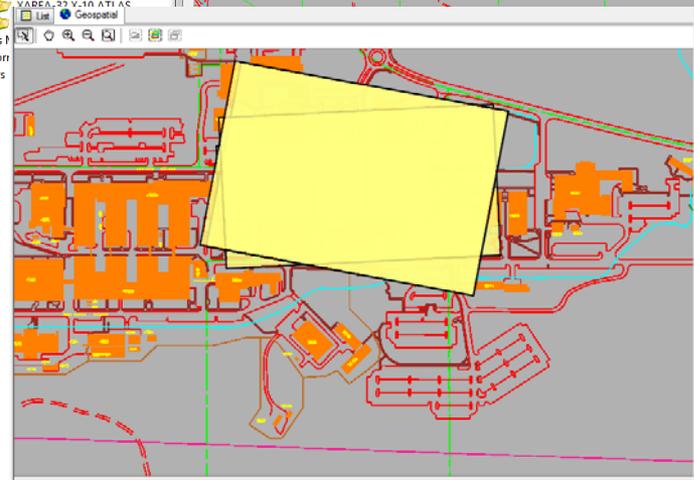
- Engineering Document Management System
 - Based on ProjectWise
 - MicroStation
 - Bentley Building Suite
 - AutoCAD
 - Revit Architectural
 - Bentley Map
 - WaterGEMS
 - MapInfo
 - ProjectWise Navigator
 - Bentley GeoWeb Publisher
 - Bentley Publisher
 - InforEAM (Maintenance Management System)

Geospatial Indexing

- Align files with “real world coordinates”
- Allows for GeoSpatial Searching
 - ProjectWise returns list of all drawings and documents associated with that area
- Automatic for CAD/BIM files
- Shapes can be defined for any file type

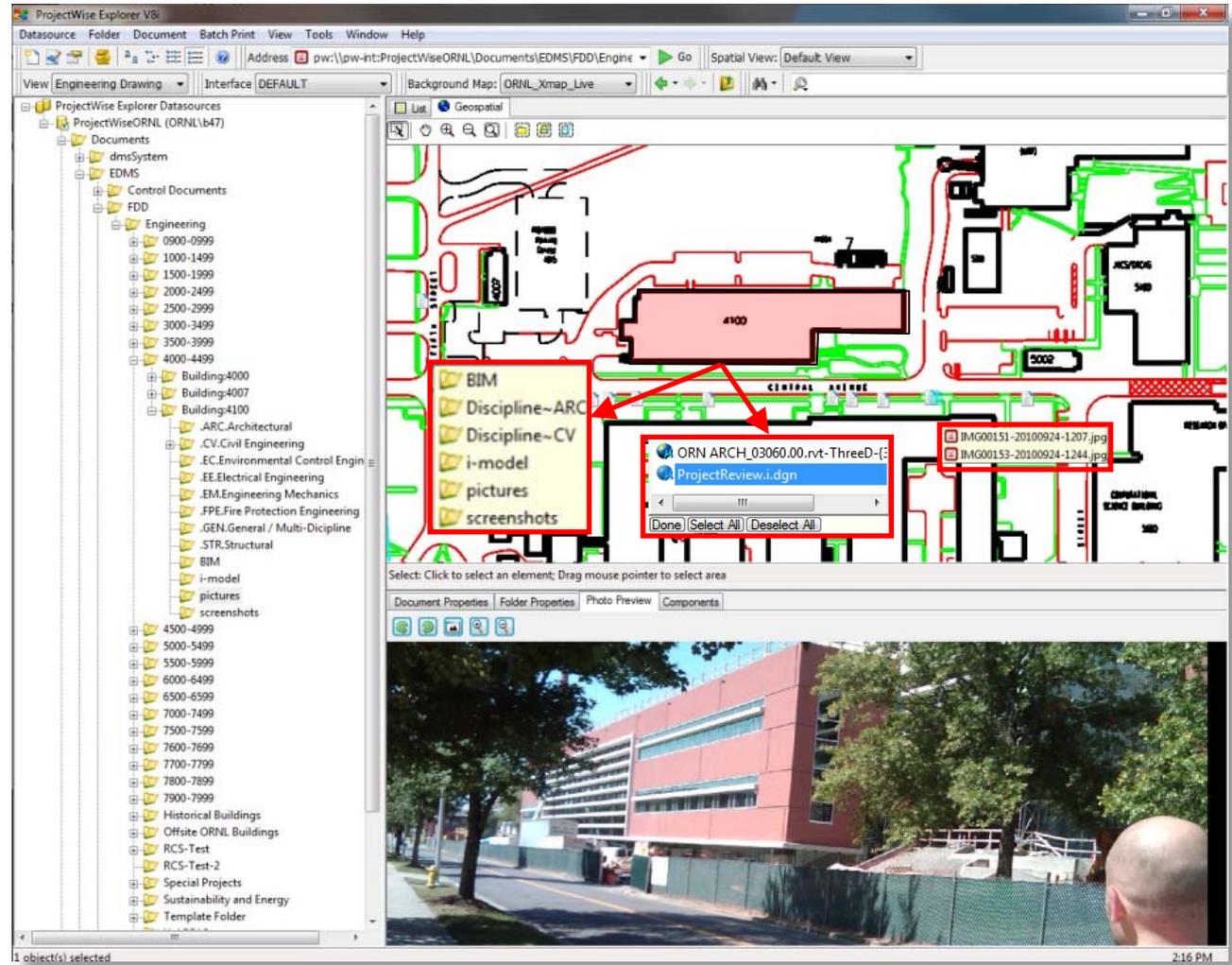


Drawing Number	Revision	Title Line 1	Title Line 2
C3E020019A418	000	LAYOUT PLAN - WEST	
C3E020019A420	000	LAYOUT PLAN - EAST	
C3E020019A421	000	GRADING & DRAINAGE PLAN...	ST
C3E020019A419	000	LAYOUT PLAN - CENTRAL	
C3E020019A422	000	GRADING & DRAINAGE PLAN...	NTRAL
C3E020019A423	000	GRADING & DRAINAGE PLAN...	ST



BIM / CAD / GIS Integration

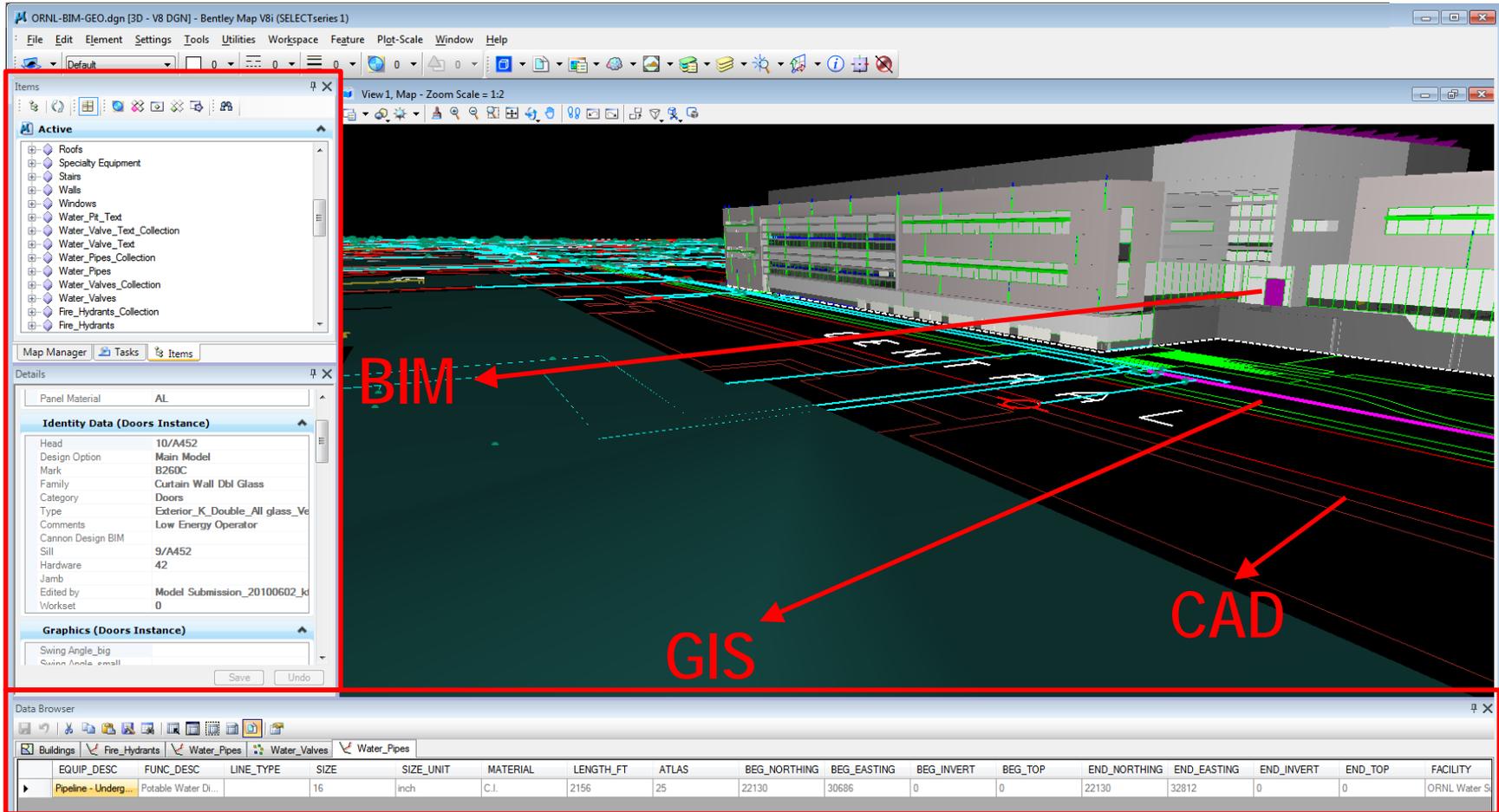
- ProjectWise View of GeoSpatially Indexed, Integrated Data



Enables ability to quickly locate relevant project data / documentation

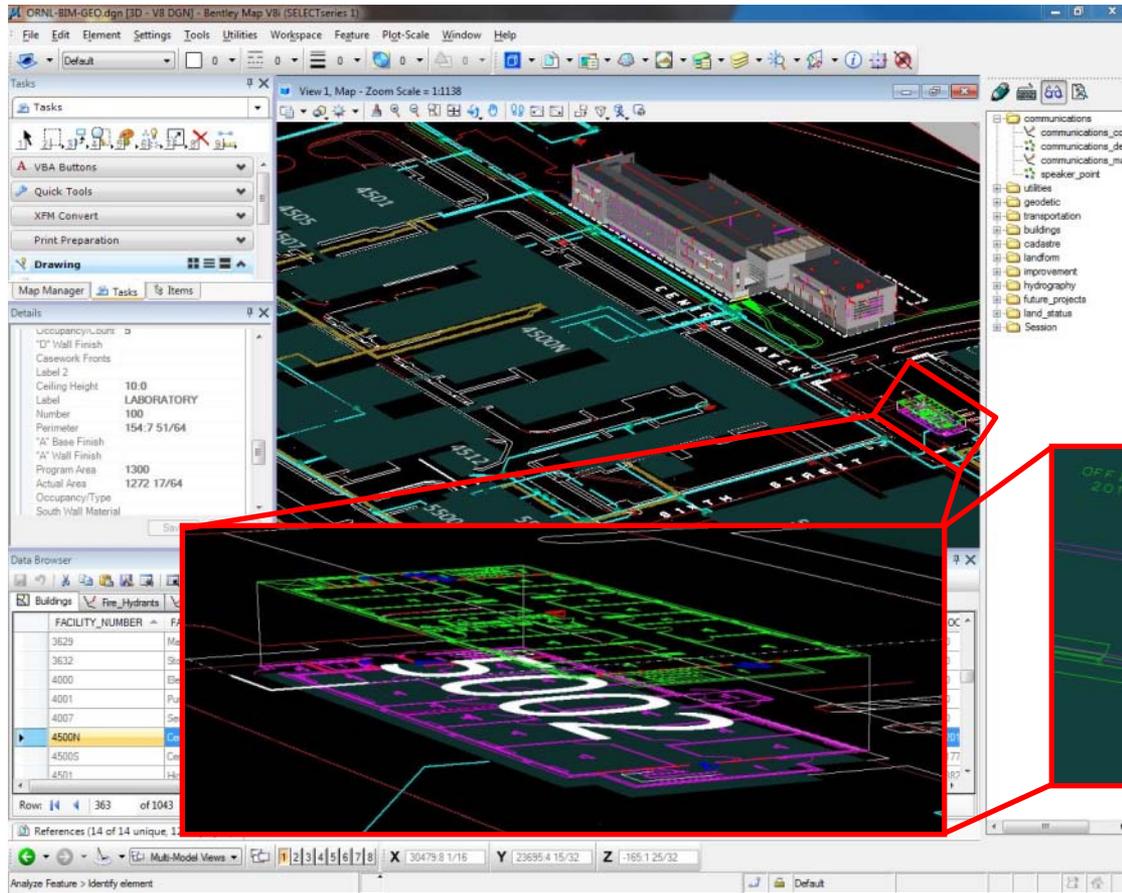
BIM / CAD / GIS Integration

- View of CIM “Master Model” in Bentley Map
 - BIM / CAD / GIS (*Utility*) Integration



BIM / CAD / GIS Integration

- Fire Barrier Floor Plan Integration (2D CAD data)



Integrated Campus Information Modeling

- GIS Data & Facility Information Center Integration

The screenshot shows the Bentley Map V8i software interface. The main window displays a 3D model of a building with various utility lines overlaid. A data table is open in the foreground, showing the following information:

Property	Value
FACILITY_NUMBER	4500N
FACILITY_DESCRIPTION	Central Research & Administration
STATUS	Operating
LOCATION	East Campus
ATLAS	39
BUILDING_CONSTRUCTION	Concrete Moment frame, brick
GROSS_SF	342812
OCCUPIABLE_SPACE_SF	201542
POTABLE_WATER	Y
PROCESS_WATER	Y
SANITARY_SEWER	Y
STEAM	Y
COMPRESSED_AIR	Y
CHILLED_WATER	Y
NATURAL_GAS	Y
ELECTRICITY	Y
FIRE_ALARM_SYSTEM	Y
FIRE_ALARM_MASTER_BOX	365, 367
BUILDING_DATA_HOTLINK	https://facilities.ornl.gov/fc/FacilityProperties.aspx?facility_number=4500N
COMMENT1	
COMMENT2	
COMMENT3	
COMMENT4	
COMMENT5	
FID	164
Geometry_Area	163714.593203
Geometry_Perimeter	4458.5 3/8

The screenshot shows the Facility Properties web application. The page title is "facility information center" and the facility name is "OAK RIDGE NATIONAL LABORATORY". The facility number is "4500N". The page includes a navigation menu with links for Home, Site Maps, Facility Ad Hoc, Facility List, Facility Search, and Service Request. The main content area is divided into several sections:

- Facility Management:** Facility Contact / LES Update, Facility Maps (1st Floor, 2nd Floor, Basement), Facility Drawings, Facilities Management Home, Facility Use Agreements, Reports, Equipment List.
- Space Management:** Facility Validation Report, Facility Validation—Operating Costs, Interactive Facility Maps, Room List, Space Allocation Management System.
- Facility Tenant Operations:** Conference Room Schedules, Reports, Facility Operations Managers, Lab Management, ISS Info.
- Information:** Site: X-10, Program: SC, Complex: Central, Facility Type: Building, Operation Status: Operating, Year Built: 1952, Resp. DOE Contractor: UT-Battelle, Employees assigned: 639, Employees with offices assigned: 493, Gross Area (built): 363,570, Net Usable Area: 208,877.
- Facility Management Contacts**

Facility Information Center

- General user Interface for all integrated Campus Information

facility information center

OAK RIDGE NATIONAL LABORATORY

Home | Site Maps | Facility List | Facility Search | Logout

Site Maps

Select a General Area from the Map Below

Full Map
Main Campus
Energy Systems Test Complex
High Flux Isotope Reactor-HFIR
Spallation Neutron Source-SNS
Back to FIC Home Page

OAK RIDGE NATIONAL LABORATORY

Main Campus

Spallation Neutron Source

High Flux Isotope Reactor

Energy Systems Test Complex

NORTH

Distances to outlying areas are not to scale

Facility Information Center

4300N

Central Research & Administration North

Facility Management
Facility Contact / LES Update
Facility Maps »
1st Floor
2nd Floor
Basement
Roof
Facility Drawings »
Fire Barrier »
Fire Barrier Drawing List
Fire Barrier 1st Floor Wing 1
Fire Barrier 1st Floor Wing 2
Fire Barrier 1st Floor Wing 3
Fire Barrier 1st Floor Wing 4
Fire Barrier 1st Floor Wing 5
Fire Barrier 2nd Floor Wing 1
Fire Barrier 2nd Floor Wing 2
Fire Barrier 2nd Floor Wing 3
Fire Barrier 2nd Floor Wing 4
Fire Barrier 2nd Floor Wing 5
Fire Barrier Basement Wing 1
Fire Barrier Basement Wing 2
Fire Barrier Basement Wing 3
Fire Barrier Basement Wing 4
Fire Barrier Basement Wing 5
Fire Barrier 5
HMCA »
HMCA Drawing List
HMCA 1st Floor
HMCA 2nd Floor
HMCA Basement
Facilities Management Home
Facility Use Agreements
Equipment List

Space Management
Facility Validation Report
Facility Validation--Operating Costs
Interactive Facility Maps
Rooms List
Space Allocation Management System

Facility Tenant Operations
Conference Room Schedules
Reports »



Information
Site: X-10
Program: SC
Complex: Central
Facility Type: Building
Operation Status: Operating
Year Built: 1952
Resp. DOE Contractor: UT-Battelle
Employees assigned: 577
Employees with offices assigned: 460
Gross Area (sqft): 363,980
Net Usable Area: 208,833

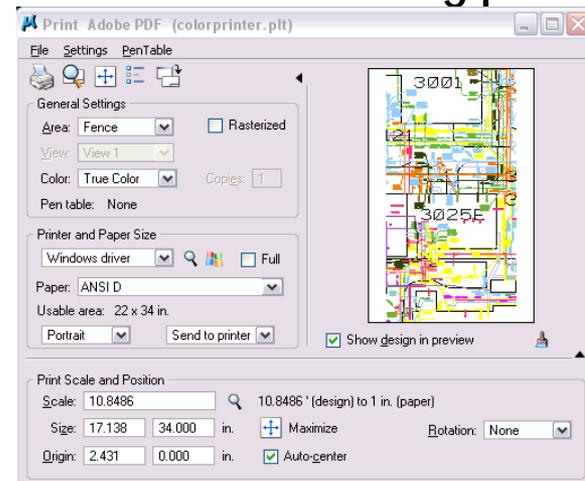
Facility Management Contacts

Utility Information Integration



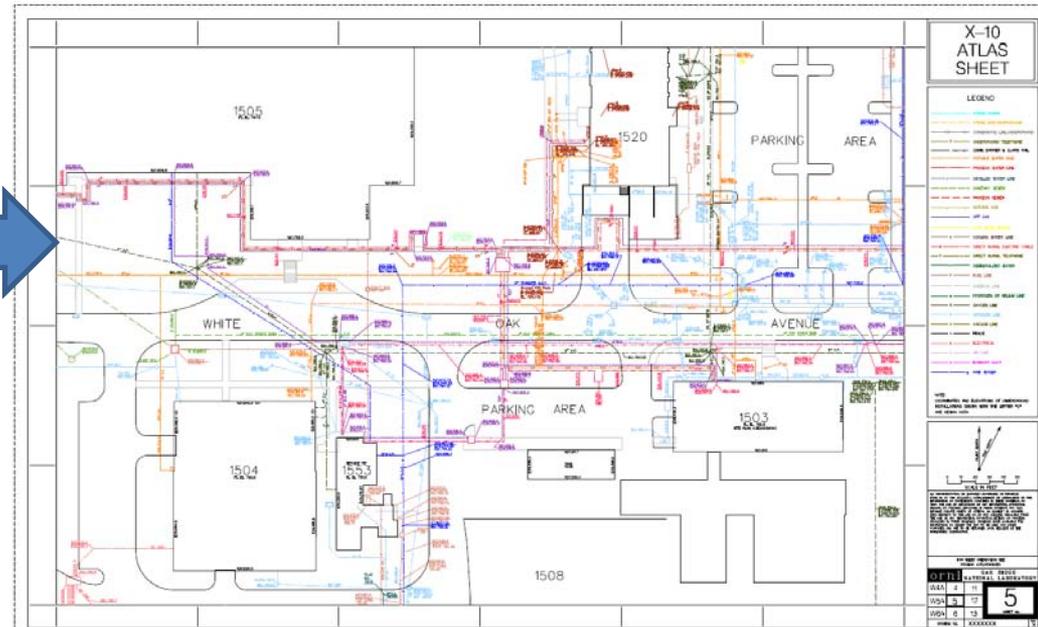
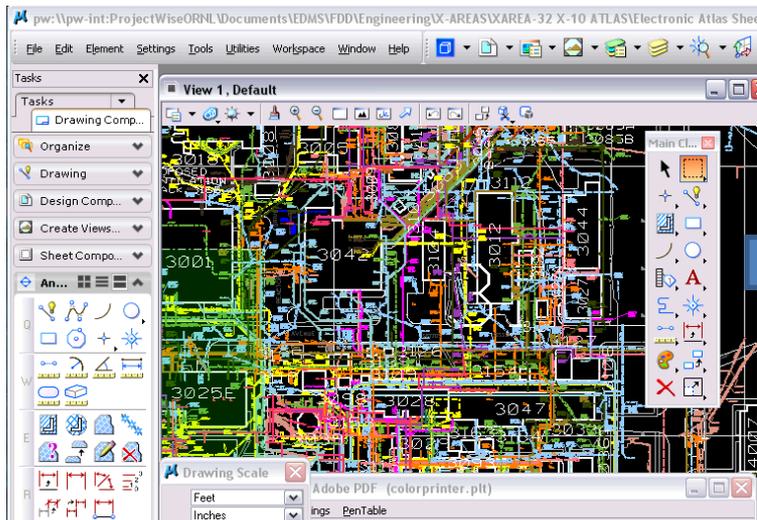
Automated PDF Distribution

- Used to Distribute Underground Utility Maps
 - All known underground utilities shown throughout campus
 - >500,000 CAD elements (excluding basemap)
 - Continuous Process of capturing as-built, as-found, and new conditions
 - Complicated system of reference files, resource files, and CAD standards managed by ProjectWise
 - General Users do not have access to or ability to use Atlas CAD files
 - Frequent requests for Utility information: time consuming process



Automated PDF Distribution

- Automatically creates PDF files every Saturday at 3:00pm
- Saves easy to read PDF files to area of ProjectWise that is accessible to anyone with an account
- Maintains CAD standards, reference attachments, etc.



ProjectWise Distribution Service

- Permanently installed and customized in ORNL's ProjectWise and can be used by anyone, as needed.
- Not just for .PDFs. Can automate hard copy (paper) printing
- Not just for CAD. Can print any file type stored in ProjectWise (.doc, .xls, etc.)



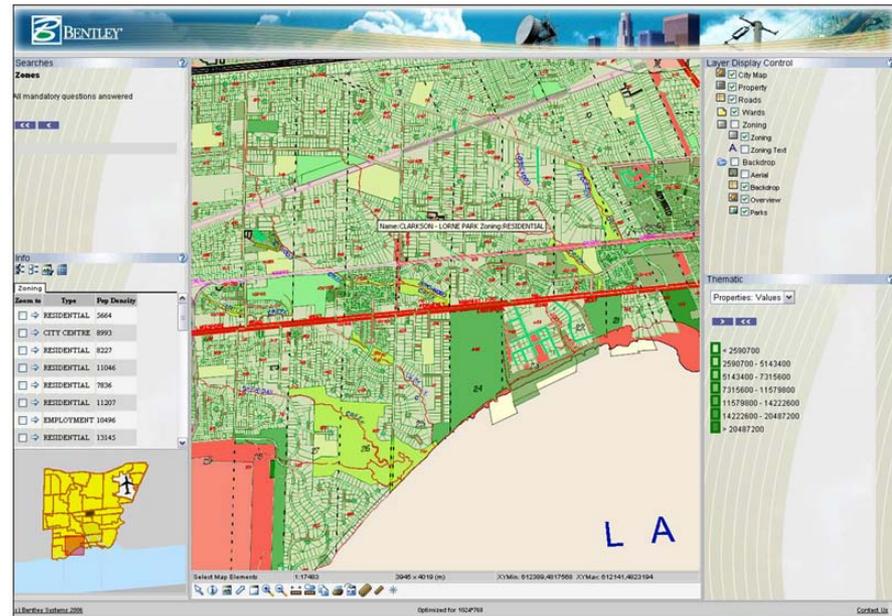
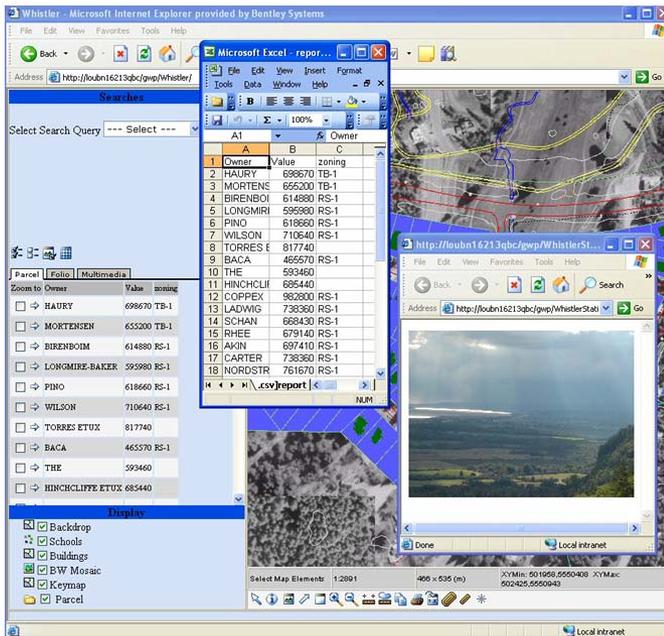
Campus Information Modeling Tools in Development

- Bentley GeoWeb Publisher
 - GeoSpatially Enabled Facility Information Center
 - GeoSpatially Enabled Maintenance Management System
- BIM Integrated Maintenance Management System
- Electronic Excavation/Penetration Permitting



Bentley GeoWeb Publisher

- Ties together multiple information sources
 - Ties together multiple information sources
 - Databases, GIS, CAD, Photos, etc.
 - Displays results on a “map” through a web page
 - GeoSpatially Enabled Facility Information Center
 - GeoSpatially Enabled Maintenance Management System



Bentley GeoWeb Publisher

- GeoSpatially Enabled Facility Information Center

Oak Ridge National Laboratory

Layers

- Site Map
- Facility Floor Plan Layers

Thematic

Building Complex

- Bectel Jacobs
- Central
- East
- Reactor
- West
- Undefined

First Floor Rooms 2/2

Oak Ridge National Laboratory

Layers

- Plan
- Basement Floor Shapes
- First Floor Plan
- First Floor Shapes
- Second Floor Plan
- Second Floor Shapes

Building 1/1

Enter Building Number

Thematic

Room by Function

- Conference
- Not Used
- Office
- Restroom
- Default Class

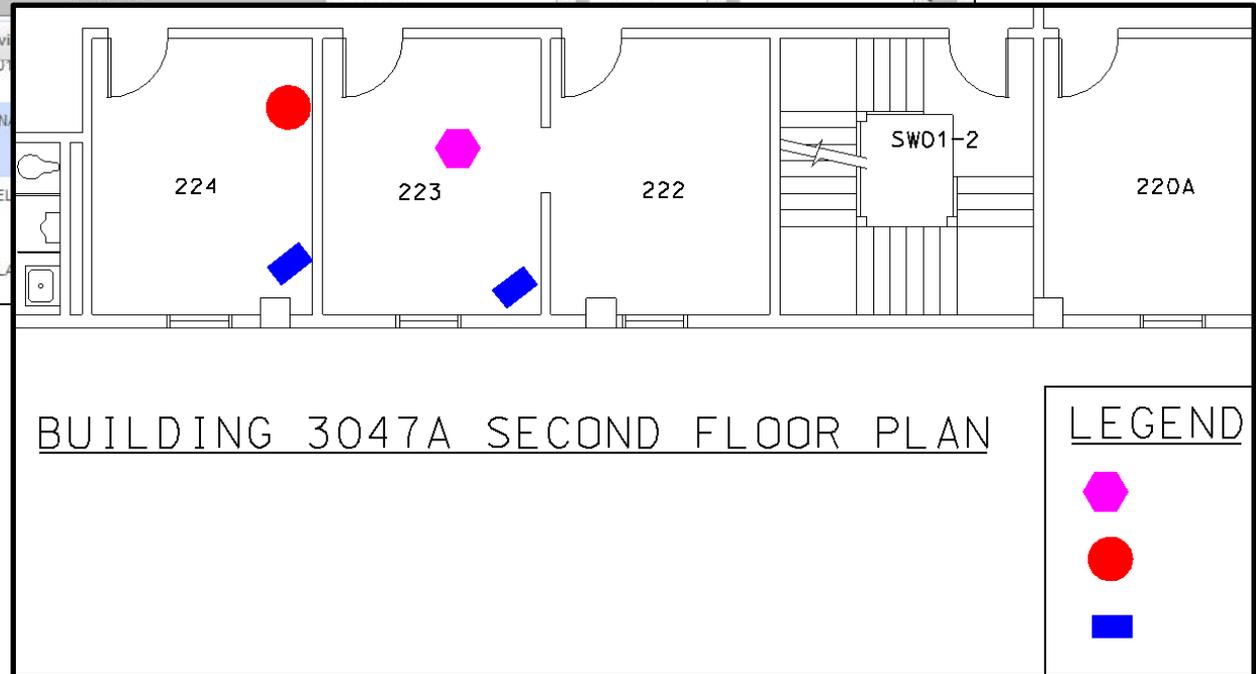
Overview

10 R

Pan 1:135 84 x 34 (ft) XYMin: 29359,21972 XYMax: 29443,22006 X=29359 Y=21981

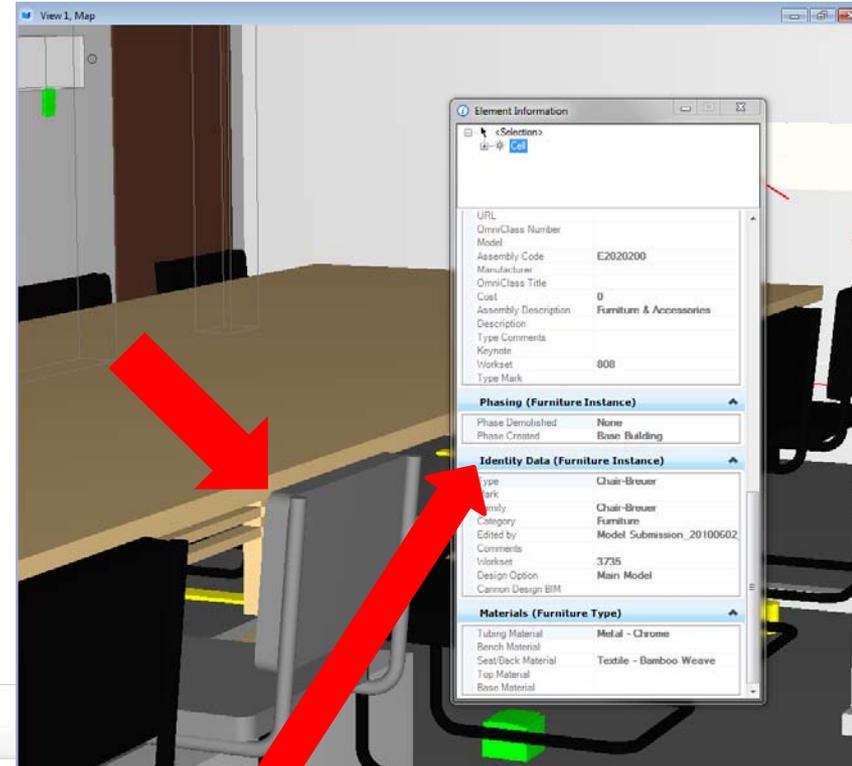
GeoWeb Publisher Integrated Maintenance Management System

Work Order	Description	Status	Service
1346112	Upgrade 7918 break room	In Planning	RC-UT
1346111	Repair cork board, falling off wall	Requires NNFD Approval	NA-N
1346107	Replace toggle lights switches with motion-detector switches	Ready To Work	CC-EL
1346106	Move filing-cabinet/safe from E-30 to 4500N attic	New Work	CC-LA



- Display Equipment location (from database) on map.
- Different Symbols for different equipment types.

BIM Integrated Maintenance Management System



API's Currently being developed by Bentley Systems

INTEGRATED EAM ENTERPRISE EDITION

Facility Service Center - Production

Asset: AC-0000326 Refrigerated Centrifuge

Organization: ORNL-MAIN
Service Org: WC-01
Status: Installed

List View | Record View | Comments | Events | Structure | PM Schedules | Calibration | Test Points | Documents | Meters | Route Assignment | Inspection WOs

Dataspys: All Assets | Records: 30 of 100+ | Quick Filters: Asset | Contains

Asset	Description	Status	Location	Service Org	Class	Assigned To	Add'l Loc Info	Custodian	Custodian Name	Surveillance Req	Alternate ID	FAMMIS FLD	Legacy Eqp ID	Commission Date	Out of Service	Cost Obj
AC-0000326	Refrigerated Centrifuge	Installed	1505-2-277	WC-01	INSPECT	00029645	SW Outside Wall				1505-02055	1505-02055	326	11/30/2006	<input type="checkbox"/>	338000PM

BIM Integrated Maintenance Management System

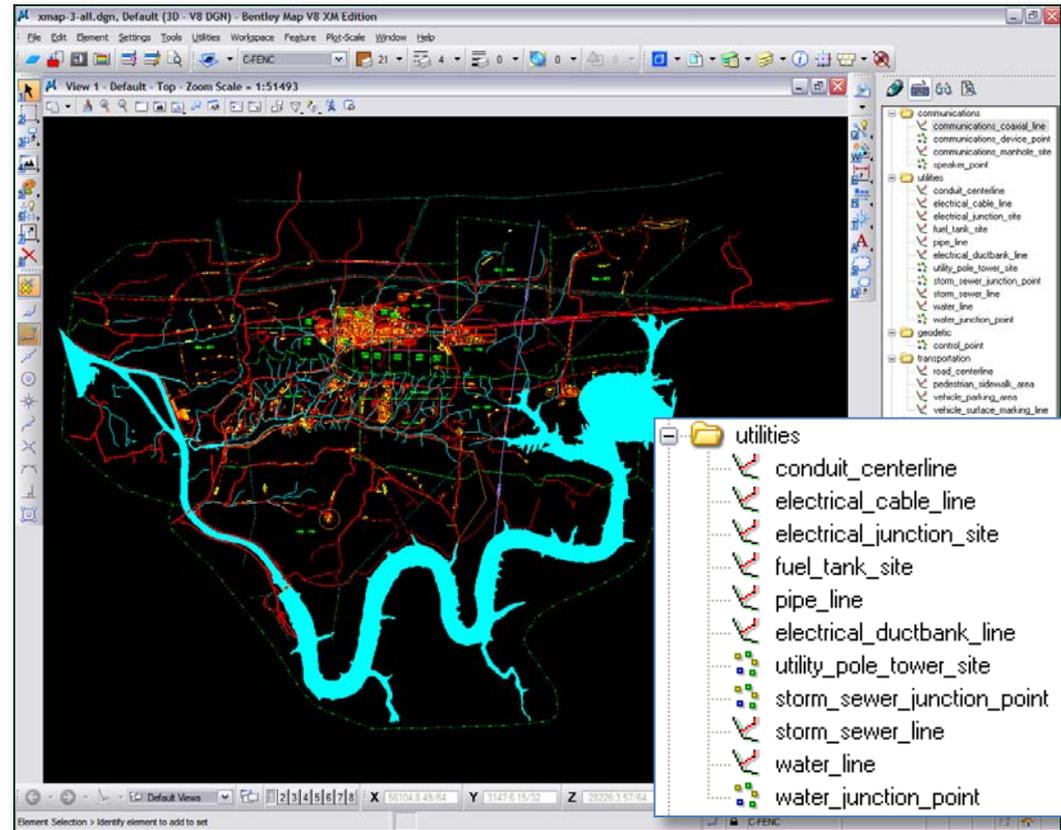
- ORNL Developed Internal Spreadsheet
 - Based on data requirements of existing ORNL systems
 - Based (loosely) on COBie format
 - 33 Key fields for each piece of equipment
 - Populated throughout design / construction / start up
 - Currently being piloted with subcontractor

Provided by A/E or Contractor - 100% Design										Provided by Contractor at 75%-100% Construction (Monthly Update and Final)										Established by ORNL Staff				Provided by ORNL Complex Personnel			
Location (Bldg-Fr-Room)	Equipment ID or Drawing	CSI Technical Specification Number (picklist)	Description	Equipment I.D. # Attach to Report # applicable and available	Number of Size	Nominal Size Dimension (hp, CFM, BTU, etc.)	Manufacturer (picklist)	Model	Serial Number	Install Date	Cost	Warranty T (Y/M)	Warranty Length (Days)	Warranty Start Date	Warranty Document File Name	FSC Asset ID	FSC Position	FSC Class	FSC Category	BARB Comp ID	System (WBS Level 2)	Service Org	Cost Object	PM Schedule	Construction	Spv. Eng.	
AHU 101	230553-identification for	Air Handler		800	CFM	York YCFK	XTO 0451072 FAK4046A	DCSMX1034								04LLA-0461	S-00-HVAC	HVAC-U-10	HVAC-U-10-HVAC-U-10	HVAC-U-10-HVAC-U-10	UC-U10L00P	0LP0000	PM-S-F	Y582	948280		
CH-1	230553-identification for	Chiller		625	TUN	Carrier Manufacturing Company	YL4L008ULR6	HESM178628																			
EF-1	230553-identification for	Exhaust Fan		542	CFM	Trane Company-TRANE	TS35300012	8873-1																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
1	Name	CreatedBy	TypeName	Space	Description	ExtSystem	ExtObject	ExtIdentifier	SerialNumber	InstallationDate	WarrantyStartDate	TagNumber	BarCode	AssetIdentifier													
2	Email	Name	Name	objComponent																							
3	Instruction	Contact	Facility	Floor	Space	Zone	Type	Component	System	Spare	Resource	Job	Document	Attribute	Coordinate	Connection	Issue	PickLists									

Electronic Excavation/Penetration Permitting

- Based on USAF Air Combat Command's Civil Engineering Work Clearance Request
 - Using "Enterprise Bridge" Technology
- Tool to help Permit Reviewers more efficiently and accurately identify hazards.
 - » Utilizes ProjectWise's GeoSpatial Component Indexing capability to identify utility systems located near planned activities.
- Enable Reviewers to review information and "sign-off" on permits *concurrently* without the need to print, queue, and hand-carry paper copies.



Campus Information Modeling at ORNL

- Questions?

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belcherdf@ornl.gov

Oak Ridge National Laboratory
Facilities Development Division

