SECTION 25 15 23

GRAPHICS

PART 1 - General

1.1 SUMMARY
   A. Section includes the general requirements for graphic generation.
   B. Related Sections:
      1. 25 12 23 Client-Server Information/Database Integration
      2. 25 15 00 Building Control Systems Server Software

1.2 REFERENCES
   A. Refer to 25 00 00 Integrated Automation

1.3 DEFINITIONS
   A. Refer to 25 06 11 Integrated Automation Definitions

1.4 SYSTEM DESCRIPTION
   A. Provide software and labor for graphical representation of all systems specified.
   B. Show all hardware points, setpoints, integrated points as shown in drawings and as needed to properly control and monitor systems.

1.5 SUBMITTALS
   A. Stanford University has developed campus standards including detailed graphics templates (Px Graphic) contact Stanford University FAC for latest examples.
   B. Submit for Review:
      1. Each graphic page shall be submitted for review and requires approval by Owner.

1.6 QUALITY ASSURANCE
   A. All graphics shall be rendered as N4 HTML 5 views. Any graphic page that depends on JAVA-based animated widgets, or in any way depends on any browser-side-applet shall not be acceptable.
   B. Provide Scalable Vector Graphic (SVG) format where possible.
   C. Text fields, column header labels, button labels, etc. must be a text string. Mapping text strings, from Niagara string objects or Tags, is acceptable; mapping Niagara object names to text fields is not acceptable.
   D. Decimal precision. Unless indicated otherwise, point values shall use the following decimal precision. Temperatures and temperature setpoints: 1 decimal place. Airflow (CFM) and airflow setpoints: no decimal places. Water flow (GPM) and water flow setpoints: 1 decimal place. Duct static pressure (Inches Water Column) and duct static pressure setpoints: 2 decimal places. Building static pressure (Inches Water Column) and building static pressure setpoints: 3 decimal places. Humidity (%RH) and humidity setpoints: 1 decimal place.
   E. All valve and damper output positions should be denoted as %OPEN
   F. Provide consistency in measurement units.
G. Graphics for identical mechanical systems shall utilize relative ORD’s to minimize number of graphics. Graphics for identical mechanical systems that utilize absolute ORD’s are not acceptable.

H. All graphics shall conform to the Stanford Identity Design Guidelines.

I. All graphics shall conform to the Stanford University N4 standards document.

J. Vendor names, logos, hyperlinks to vendor site, or other vendor identification or promotion, are not permitted on graphics.

K. Owner shall furnish sample Stanford Standard Graphics to ensure consistency of look and feel across all Niagara sites.
   1. Stanford Standard Graphics, furnished to Contractor, are dynamic with programming code embedded in the graphics. Contractor may not modify embedded programming code, variable ORD schemes, color schemes, spectrum binding weighting values, BQL queries, etc., in graphics, unless approved by Owner.
   2. Screen captures of example Stanford Standard Graphics are depicted below.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 GRAPHIC GENERATION

A. Each graphic shall include all control points, devices and user adjustable setpoints/parameters associated with the system. All points, as specified in points list table, shall be displayed and adjustable in graphics.

B. User adjustable points, displayed on any graphic page, shall be identifiable by highlighting (turn blue) upon mouse over.

C. Provide links, in a "breadcrumb trail" navigation menu, that allow a user to logically navigate all graphics in a hierarchical manner.

D. There shall be only one graphic header file that shall be used as a "PX Include file" on all graphics required for the project.

E. Graphic Pages Required.
   1. At a minimum, all the example graphics depicted below, shall be included as part of the project.
   2. Additional graphic pages may be required for a specific project.

F. Operator specific password access protection shall be provided for each application to allow the administrator to limit access to point control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password. There shall be 6 access levels as defined below.
   2. Administrator – Full WebUI and Workbench access to Station except to files that can potentially corrupt database. Can set or override adjustable setpoints on graphics. Can set passwords and add users.
   3. Integrator - WebUI and Workbench access to Station. Same access level as Administrator except cannot set passwords and add users. Can set or override adjustable setpoints on graphics. Can change own user name, password and email address.
4. Programmer – WebUI and Workbench access to Station. Same access level as Administrator except cannot set passwords and add users. Can set or override adjustable setpoints on graphics. Can change own user name, password and email address.

5. Operator – WebUI access only. View all graphics and override points only, no set point access, can acknowledge alarms. Can override adjustable setpoints on graphics. Can change own user name, password and email address.

6. Read Only – Read only WebUI access. Can change own user name, password and email address.

7. Scheduler – Read only WebUI access with ability to modify equipment schedules as required. Can change own user name, password and email address.

8. Owner will furnish a written matrix of Categories, Permissions and Roles that must be followed exactly.

G. All overrides are globally limited to a maximum of 96 hours.

3.2 DATABASE FOLDER STRUCTURE

A. Niagara file structure must be consistent across all buildings. Below is a view into the supervisor NiagaraNetwork and px files directory.

B. This structure provides a way to isolate each building graphical interface into a portable segment in the database.
1. The NiagaraNetwork and the Files directory are constructed using the same format.
   a. Root Directory: campus; NiagaraNetwork displayname: Campus
b. 2nd Level Directory: qxx (quad number); NiagaraNetwork displayName: Quad xx

c. 3rd Level Directory: bxxx (building number); NiagaraNetwork displayName: Quad-Building Building Name

2. Under each building folder proxy in all Jaces associated with that building.
   a. Under JACE “points” folder build out all systems with dedicated folders as to best create relativized graphics.

3. Separate Trends, Alarms, Reports, Schedules under building folder to automate header button functionality.

3.3 COMMON FOR ALL GRAPHICS

A. Header:

   Header is one PX Include file for the entire project that shall appear on every graphic page. For efficiency of graphics maintenance, all links, labels, etc., shall be edited from only one instance of header. With the exception of Building Name, the header and each of the link buttons should appear exactly the same on all campus buildings.

1. Building Name
2. Stanford Logo
3. Label: Back; Link: Returns user to previous graphics page.
4. Icons: Links:
   a. Trends; Link: Chart Viewer Page.
   b. Alarms; Link: Alarm Viewer Page.
   c. Reports; Link: Reports Selection Page.
   d. Schedule; Link: Schedule Selection Page.
5. Bread Crumb Trail Menu Navigation (details below).
B. Footer:
Footer is one PX Include file for the entire project that shall appear on every graphic page. For efficiency of graphics maintenance, all links, labels, etc., shall be edited from only one instance of footer. Footer buttons shall vary by building depending on what mechanical equipment, etc. is being controlled in the building. The following is a typical example:

Include the following:
1. Label: Floor Plans; Link to: Floor Plan Selection page
2. Label: Air Handlers; Link to: Air Handler page
3. Label: CHW System; Link to: CHW System page
4. Label: HW System; Link to: HW System page
5. Label: PCHW System; Link to: PCHW System page (If PCHW System in project scope)
6. Label: Cold Rm Overview; Link to: Cold Room Overview page (If cold rooms in project scope)
7. Label: FHC Overview; Link to: Fume Hood Control System Overview page (If fume hoods in project scope)
8. Label: VAV Overview; Link: VAV Overview or VAV Overview Selection page (depending on number of Variable Air Volume Terminal Units in project scope)
9. Label: Lab Overview; Link: Lab Overview page (if labs in project scope)
10. Label: S.O.O; Link: Sequence of Operations (PDF format)
11. Additional footer buttons may be required for each specific project depending on equipment controlled, i.e, FCU Overview page if Fan Coil Units in project scope.

C. Bread Crumb Trail Menu Navigation:
The “Bread Crumb Trail” Menu Navigation consists of dynamic buttons and links that appear as required by context to facilitate logical user navigation of the graphics. Graphics examples below shall indicate Bread Crumb Trail menu navigation buttons germane to each specific graphic page.
3.4 HOME PAGE

A. The primary purpose of the building home page is to provide an Operator one place to quickly see the status of major equipment in the building and other critical, real-time information. The contents of the home page will vary by building depending on critical systems and mechanical equipment in that building. Typical systems include air handlers; building chilled water; building hot water, etc.

B. Home Page Example:

1. Header (Bread Crumb Trail Links to campus and quad navigation pages)
2. Preferred Typical Equipment/System Summary. Mechanical system name text shall be in Blue Underline to indicate hyperlink to a more detailed display of system. Mechanical system name text shall be in Black if no hyperlink is present.
3. Critical Alarms (can have special alarms as separate groups).
4. Footer Button
3.5 GRAPHICS PAGE SAMPLES

A. It is not feasible to convey examples of every possible permutation of equipment configurations. Specific details shall be developed on a per-project or per-building basis.

B. Typical Air Handler Graphic Page

Ensure use of the latest SVG modules for all equipment schematics.

1. Bread Crumb Trail Menu dynamically expanding to provide current location and navigation.
2. Settable points highlight blue
3. Add reset or request information or any other essential points as needed.
4. 
3.6 VARIABLE AIR VOLUME BOX – NO REHEAT (COOLING ONLY)

A. Example Cooling Only VAV Box Graphic

1. Can provide “Air Inlet Temp” if temperature available from Air Handler virtually or local sensor.
2. For cooling only VAV, do not show any information associated with heating modes.

*Provide Air Handler information as shown if available.*
3.7 LAB VARIABLE AIR VOLUME BOX – WITH EXHAUST

A. It is not feasible to convey examples of every possible permutation of Lab Exhaust configuration. Specific details shall be developed on a per-project or per-building basis.

B. Example Lab VAV Box with Exhaust Graphic
3.8 LAB VARIABLE AIR VOLUME BOX – WITH FUME HOOD EXHAUST

A. It is not feasible to convey examples of every possible permutation of Fume Hood exhaust configuration. Specific details shall be developed on a per-project or per-building basis.

B. Example Lab VAV Box with Fume Hood Exhaust Graphic
3.9 FLOOR PLAN

A. Example Floorplan Graphic

1. Embellished Description of Floorplan (optional, as required).
2. T-stat location, static but editable from Niagara graphics editor. Shall not require editing of background image.
3. Box level summary table with VAV box identification, space temperature, and identification of the AHU serving the box. This table includes a navigation link to the specific VAV box.
4. Typical animated spectrum binding of entire area served by VAV box to indicate zone temperature. Zone color shall go from light blue to bright blue with greater deviation below effective setpoint and from light red to bright red with greater deviation above effective setpoint. Zones between heating and cooling setpoint shall be light grey. Each spectrum binding shape shall maintain approximately 10 pixel space to distinguish from adjacent spectrum binding shape to prevent confusion when both shapes are the same color. Entire spectrum binding shape shall be a navigation link to the specific VAV box. Upon mouse over, mouse cursor icon shall change from pointer to hyperlink.
5. Room Number, static but editable from Niagara graphics editor. Modifying room number shall not require editing of background image.
6. Key Plan. Required when one level of building layout is split into multiple floor plan sections. Key Plan depicts current floor plan section, relative to entire floor plan. Lightened Key Plan Section(s) indicates additional sections of floorplan on same level and serves as link to those additional sections of floorplan.
7. Darkened Key Plan Section indicates section of floorplan currently being displayed.
3.10 VAV OVERVIEW TABLE

A. Example VAV Overview Page (one page per air handling unit, per floor)

1. Link to specific VAV graphic
2. Column Label: Zone; Cell Contents: VAV Box ID; Link: Specific VAV graphic; Mouse Over: Highlight; Edit: Programmer-Level or higher.
3. Column Label: T Rm #; Cell Contents: Room number that VAV thermostat is physically located in.; Link: None; Mouse Over: Highlight; Edit: Programmer-Level or higher.
4. Column Label: Description; Cell Contents: Additional rooms served by VAV box.; Link: None; Mouse Over: Highlight; Edit: Programmer-Level or higher.
5. Column Label: Reset Multiplier; Cell Contents: Integer value of reset weighting (Zone Criticality); Link: None; Mouse Over: Highlight; Edit: Programmer-Level or higher.
6. Column Label: Temp; Cell Contents: Space Temperature; Link: None
7. Column Label: Mode; Cell Contents: VAV Operating Mode, Indicate “Cool” and color Blue, when in cooling mode, Indicate “Heat” and color Red, when in heating mode, Indicate “Deadband” and no color, when in deadband mode; Link: None.
8. Column Label: Cooling Setpoint; Cell Contents: Cooling Setpoint; Link: None
9. Column Label: Heating Setpoint; Cell Contents: Heating Setpoint; Link: None
10. Column Label: HWV Command; Cell Contents: Heating Water Valve Command; Spectrum Binding: Red 0-100%; Link: None. Indicate “N/A” on cooling-only VAV’s.
11. Column Label: Cooling Demand; Cell Contents: Cooling Demand; Spectrum Binding: Blue 0-100%.
12. Column Label: Heating Demand; Cell Contents: Heating Demand; Spectrum Binding: Red 0-100%.
13. Column Label: Air Flow; Cell Contents: Air Flow (CFM)
15. Column Label: Damper CMD; Cell Contents: Damper Command; Spectrum Binding: Green 0-100%.
16. Column Label: Occupancy; Cell Contents: Zone Occupancy Mode; Link: None; Mouse Over: Highlight; Edit: Programmer-Level or higher.

B. Notes:
1. Add or Remove Columns, as required by project.
3.11 LAB OVERVIEW

A. Example LAB Overview Graphic

1. See VAV Overview Table section above for Hyperlinks, Spectrum, and setpoint functionality requirements.
3.12 LAB VAV WITH EXHAUST OVERVIEW

A. Example LAB VAV with Exhaust Overview Graphic

1. See VAV Overview Table section above for Hyperlinks, Spectrum, and setpoint functionality requirements.
3.13 FUME HOOD OVERVIEW
   
   A. Example Fume Hood Overview Graphic

   ![Fume Hood Overview Graphic]

   ![Fume Hood Overview Table]

   1. See VAV Overview Table section above for Hyperlinks, Spectrum, and setpoint functionality requirements.
3.14 FAN COIL UNIT OVERVIEW

A. Example Fan Coil Unit (FCU) Overview Graphic

1. See VAV Overview Table section above for Hyperlinks, Spectrum, and setpoint functionality requirements.

3.15 EXHAUST FAN SUMMARY TABLE
3.16 TRENDS (VIEW HISTORICAL DATA)

A. The “Trends” Header Button will navigate to the History Px page.

B. History trends will be organized by Hierarchies.

C. Using Hierarchies, navigate to Drag and Drop points onto the History Viewer.
3.17 ALARM SCREENS

A. The “Alarms” Header button will navigate to the Alarm Px page.

B. Each building will have an alarm page to display alarm records.

C. Example of Alarm Page
3.18 NAVIGATION PAGES

A. Navigation or Selection pages facilitate logical site navigation with organized link buttons. Typical applications include selection from multiple Floorplans, Overviews, HVAC Equipment, Reports, etc.

B. Example of Typical Floorplan Selection Page

![Image of a typical floorplan selection page with links to different buildings and floors.]
3.19 REPORTS

A. The “Reports” Header button will navigate to reports selection page above.

B. At a minimum, the following Report Pages shall be provided:
   1. Offline Controllers
   2. Points in Override
   3. Points in Fault
   4. Points Stale
   5. Zones with Notes

C. Additional Reports may be required by specific project.

D. Example of a typical Report px page layout
### Points Currently In Fault

**Total Number of Points in Fault = 8**

<table>
<thead>
<tr>
<th>Device</th>
<th>Point Name</th>
<th>Status</th>
<th>Value and Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>RH120V PanVarm</td>
<td>[device details]</td>
<td>OFF</td>
<td>(null, null)</td>
</tr>
<tr>
<td>RH130V PanVarm</td>
<td>[device details]</td>
<td>OFF</td>
<td>(null, null)</td>
</tr>
<tr>
<td>RH140V PanVarm</td>
<td>[device details]</td>
<td>OFF</td>
<td>(null, null)</td>
</tr>
<tr>
<td>RH150V PanVarm</td>
<td>[device details]</td>
<td>OFF</td>
<td>(null, null)</td>
</tr>
<tr>
<td>RH160V PanVarm</td>
<td>[device details]</td>
<td>OFF</td>
<td>(null, null)</td>
</tr>
<tr>
<td>RH170V PanVarm</td>
<td>[device details]</td>
<td>OFF</td>
<td>(null, null)</td>
</tr>
<tr>
<td>RH180V PanVarm</td>
<td>[device details]</td>
<td>OFF</td>
<td>(null, null)</td>
</tr>
<tr>
<td>RH190V PanVarm</td>
<td>[device details]</td>
<td>OFF</td>
<td>(null, null)</td>
</tr>
</tbody>
</table>

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