VRcontext s.a. / n.v.
Avenue Tedesco 7 – 1160 Brussels – Belgium
[p] + 32 (0) 2 663 96 00 – [f] + 32 (0) 2 644 36 96
[e] info@vrcontext.com – [w] www.vrcontext.com

Ref : 600.011

Subject of this Document:

This document describes an attempt to set up a new way to share information between Engineering, Procurement and Construction (EPC) companies, sub-contractors and Owners/Operators (O/O) of industrial installations.

The shared information includes 3D CAD drawings, Database information, Computational Fluid Dynamics (CFD) information, Laser scanning information and Animation information.

1. Owner/Operators Needs

Industrial plants and installations are ordered by O/O, studied by engineering offices and built by construction companies.

The more complex is the layout and the process, the more frequently 3D CAD software will be used. These software are producing 3D CAD models that could be very useful for O/O businesses during the marketing phase, the start-up phase, the exploitation phase and the decommissioning phase.

These 3D CAD models can also be used for asset management, facility management, maintenance training, safety training, process simulation and training.

Other data types are also useful to cover these needs like laser scanning, technical information, animation sequences and CFD.

2. Owner/Operators Issues

The intent of the current document is to prescribe a new communication standard between all actors producing or having to use 3D information or any other information connected to 3D models.

The following sections will describe the shortcomings related to the idea of exchanging, storing and using 3D information.

- **Problem with CAD Software**

Engineering offices and Construction companies are using multiple CAD software of different types:

- Plant Design (PDS, PDMS, Rebis, PlantSpace, etc.)
- Mechanical (CATIA, SolidWorks, ProE, Inventor, etc.)
- Plain CAD (MicroStation, AutoCAD, etc.)
- AEC (Triforma, REVIT, ArchiCAD, etc.)
- Marketing, Communication (3ds Max, Maya, etc.)
- etc.

O/O cannot acquire all these software, train people on these software and maintain skilled staff over the years for all these software.

Another concern is the availability of these CAD software over the years covering the entire life cycle of installation. If the software does not exist anymore, it is difficult to get access to the information stored in the CAD files.

VRcontext s.a. / n.v.
Avenue Tedesco 7 – 1160 Brussels – Belgium
[p] + 32 (0) 2 663 96 00 – [f] + 32 (0) 2 644 36 96
[e] info@vrcontext.com – [w] www.vrcontext.com

- **Problem with Databases**

Engineering offices and Construction companies are storing technical information in multiples databases:

- Plant Design Databases
- Spreadsheet
- SAP Plant Maintenance Module
- Oracle
- PlantSpace (Bentley)
- etc.

O/O cannot acquire all these database software or set up conversion tools for all of them.

- **Problem with Laser Scanning**

Engineering offices and Construction companies are more and more using laser scanners to acquire existing environments. O/O are more and more revamping, instead of building entirely new installations. In most of the cases, scanning is sub-contracted, sometime with multiple laser scanners and sometimes with multiple brands:

- Z+F
- Leica
- Riegl
- Mensi
- Quantapoint
- iQvolution
- Visi Image
- etc.

All these scanners are storing results in incompatible file formats and are using different point clouds viewers.

Laser scanning results are used to take measurements or to plan equipments movements. Before beginning these actions, it is necessary to merge the laser point cloud(s) with some 3D CAD models of new equipments, buildings or facilities.

Unfortunately, laser point clouds are difficult to import in CAD software, and when it is achieved, it appears that the mix of data is difficult to manipulate.

It is also difficult to display laser scanning results in the same environment as the 3D CAD models.

- **Problem with Computational Fluid Dynamics**

Engineers are using CFD software to simulate explosion, smoke propagation, and toxic gas propagation. In most of the case, these simulations are achieved to optimize plant layouts, reinforce insulation or plan escape pathways. To run such simulation, it is necessary to convert some 3D CAD models to finite elements meshes and then run the simulation in a CFD software such as:

- Fluent
- Pheonics
- Flacs
- CFS
- etc.

VRcontext s.a. / n.v.
Avenue Tedesco 7 – 1160 Brussels – Belgium
[p] + 32 (0) 2 663 96 00 – [f] + 32 (0) 2 644 36 96
[e] info@vrcontext.com – [w] www.vrcontext.com

The results are stored in specific files formats, most of the time complex to understand and only useful when viewed with a specific CFD viewer. These CFD viewers are showing very simplified layout of the site with colored areas representing multiples values of smoke/fire/gas intensities or propagation speed. These results are quite always very difficult to understand for O/O – if not impossible to relocate in the complete and complex plant layout.

- **Problem with Animation data**

Engineers, specialized companies or even O/O are sometime using 3D models to demonstrate specific construction sequences, cranes movements, escape procedures, maintenance sequences, or any other operation involving objects in motion.

Most of the standard CAD software are not able to handle such kind of applications. Some specific tools, like 3ds Max, can be used with some efficiency, but these tools are not able to read 3D CAD models with their entire complexity. It is therefore difficult to know if the animation or movie will include everything related to the shown operation. The problem comes when there are missing parts and when the subcontractor equipment or operation clashes with these parts.

If animation data is used to create Virtual Reality applications, the animation parameters and triggers are most of the time stored with the Virtual Reality files (like 3ds Max or VRML files).

It is therefore difficult to keep and update animation data during the life of CAD data, because the CAD files are updated with CAD software and the relationship with the animation data are lost or overwritten.

3. PLASMA – The Concept

The previous sections described problems related to the use of 3D data. These data are complex, most of the time incompatible between application or hardware, difficult to maintain during the entire life cycle of a plant, or hard to understand or to update without a good knowledge of specialized tools.

PLASMA concept tries to solve these issues by proposing a new data exchange file format able to handle all the kind of 3D data which the O/O will have to use during the lifecycle of its assets.

4. PLASMA Features

- PLASMA file format is public
- PLASMA does not intent to become part of IEEE, ISO or any other committee result
- PLASMA file format is easy to understand
- PLASMA files are easy to create, read, and maintain
- PLASMA files are able to store information coming from the 3D model and information belonging to the life cycle of the plant
- 3D model data = 3D CAD, Laser point cloud, Database information
- Plant Life Cycle data = CFD, Animations, Links to running databases, DCS, SCADA, and external documents

5. PLASMA – The Content

The 3D Model data:

- 3D Model geometry to its highest mathematical level
- Laser Point Clouds
- Equipment Functional References
- Zones, Layers, Colors, Textures Lights

The Plant LifeCycle Related Information:

VRcontext s.a. / n.v.
Avenue Tedesco 7 – 1160 Brussels – Belgium
[p] + 32 (0) 2 663 96 00 – [f] + 32 (0) 2 644 36 96
[e] info@vrcontext.com – [w] www.vrcontext.com

- Equipments Embedded Behaviors
- CFD solutions or information to run real time
- CFD simulation
- Degree of Freedom (DOF) of objects
- Escape Pathways
- Chemical and Radioactive Information
- Storage Zones, Work Zones, Cranes
- etc.

6. PLASMA usage

All 3D files are converted to PLASMA files.

Database information can be exported to PLASMA files or a functional reference can be stored in the CAD file and used later on to access the real time database and external documents (spreadsheets, schemas, drawings, isometrics, P&ID, documents, web pages, etc.)

Unified 3D models of the entire plant are built from PLASMA file library.

O/O can use PLASMA files for their own purpose, with a far better confidence in compatibility and perenniality of their data.

7. Question

Do you endorse the PLASMA initiative in the name of your company?

If you cannot endorse it yourself, could you please ask a company representative to sign in and give us his name and title?

By endorsing, you signify that your company is interested in the success of the PLASMA initiative and is interested to use such new kind of data exchange file format.

8. PLASMA File Format

The following sections describe the structure and content of PLASMA files:

- CAD files
- Lighting files
- Laser Point Clouds files
- CFD files
- Database files
- Animation files

VRcontext s.a. / n.v.
Avenue Tedesco 7 – 1160 Brussels – Belgium
[p] + 32 (0) 2 663 96 00 – [f] + 32 (0) 2 644 36 96
[e] info@vrcontext.com – [w] www.vrcontext.com

CAD Files

CAD files will always be exported to 3D Model geometry to its highest mathematical level.

It will handle the following geometry elements:

- Polygons, complex polygons, cones, cylinders, elbows, surfaces of projection, surfaces of revolution and Bezier surfaces
- All surfaces could be capped or uncapped. Capped surfaces are seen as volumes (solids)
- Symbols (any sequence of geometry plus a name)
- Meshes (bunch of polygons with shared normals)
- Each Geometry Element can have the following attributes:
    1. Reference or Zones name
    2. Layers name
    3. Colors in RGB
    4. Textures Name, Scale, Offset, Angle, Flip, Translucency, Alpha mask
    5. Equipment Functional References
- No hierarchy is stored
- Files can be ASCII or Binary

Lighting Files

- Ambient light
- Sun position, project position on Earth (latitude and longitude) and rotation
- Spot lights (intensity, color in RGB, fall off distance, cone angle, rotation matrix)
- Point Light (intensity, color in RGB, fall off distance)
- Area Light (reference of object in CAD model, intensity, color in RGB, fall off distance)
- File is ASCII

Laser Point Clouds Files

- Type of point cloud file (Black and White, Grey scale, Intensity, Color)
- Intensity range
- Origin
- Units
- Rotation matrix
- XYZ coordinates of points, with additional values on the same line
- File can be ASCII or Binary

CFD Files

- Grid spacing and sequencing description
- Type of variables: speed, direction, pressure, temperature, etc.
- Origin
- Units
- Rotation matrix
- Values for variable 1 (row by row)
- Values for variable n (row by row)
- File can be ASCII or Binary

Database Files

- Reference (same as found attached to Geometry or Symbol element in 3D CAD files)
- List of fields and field contents
- Database URL, Table Name, Record Name, Index
- File can be ASCII or Binary

VRcontext s.a. / n.v.
Avenue Tedesco 7 – 1160 Brussels – Belgium
[p] + 32 (0) 2 663 96 00 – [f] + 32 (0) 2 644 36 96
[e] info@vrcontext.com – [w] www.vrcontext.com

Animation Files

- Vector
- Start position on vector, End position on vector, Step, Speed, Loop Toggle
- If movement is displacement, position is one value in model units
- If movement is rotation, position is angle using right hand rule for 0 value
- Hierarchical animation is achieved through nesting of references
- Embedded behavior type
- Movement
- Explosion
- Smoke
- 3D Sound
- Trigger
- Command
- etc.
- File can be ASCII or Binary

Explosion, Smoke, 3D Sounds have specific settings.
Triggers have reference of other object to activate.
Commands are ordering the running software to execute command.

9. PLASMA Initiative

Companies endorsing the PLASMA Initiative:

Laser Scanner Manufacturers

Pending: Leica, Z+F, QuantaPoint, VisiImage, Mensi, Riegl, iQvolution
Endorsed:

Owners/Operators

Pending: Shell, Japan Gas Company, DOT
Endorsed: Petrobras

Engineering, Procurement and Construction Companies

Pending: Chiyoda, Halliburton, CH2M, Tractebel, Parsons, Jacobs, Fluor, SNC-Lavalin
Endorsed:

Software companies

Pending: Intergraph, Bentley, AVEVA, Autodesk, Dassault Systèmes, SAP, Microsoft, Oracle
Endorsed: