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Evolving the JET virtual reality system for delivering the JET EP2 shutdown remote handling tasks

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ABSTRACT

The quality, functionality and performance of the virtual reality (VR) system used at JET for preparation and implementation of remote handling (RH) operations has been progressively enhanced since its first use in the original JET remote handling shutdown in 1998. As preparation began for the JET EP2 (Enhanced Performance 2) shutdown it was recognised that the VR system being used was unable to cope with the increased functionality and the large number of 3D models needed to fully represent the JET in-vessel components and tooling planned for EP2. A bespoke VR software application was developed in collaboration with the OEM, which allowed enhancements to be made to the VR system to meet the requirements of JET remote handling in preparation for EP2. Performance improvements required to meet the challenges of EP2 could not be obtained from the development of the new VR software alone. New methodologies were also required to prepare source, CATIA models for use in the VR using a collection of 3D software packages. In collaboration with the JET drawing office, techniques were developed within CATIA using polygon reduction tools to reduce model size, while retaining surface detail at required user limits. This paper will discuss how these developments have played an essential part in facilitating EP2 remote handling task development and examine their impact during the EP2 shutdown.

1. Introduction

During the JET EP1 shutdown the VR software used to assist in delivering remote handling operations was PTC DIVISION Mockup. As planning began for the EP2 shutdown it was recognised that the VR would need to provide improved real-time performance to cope with the more complex ITER like wall (ILW) tile carrier designs and resulting higher polygon count 3D models. Furthermore, a method of working which allowed multiple instances of the JET Vessel VR model to be regularly updated was also identified as a key requirement. This was because the tile carrier designs, embedded diagnostics and associated handling tooling were still evolving in design even as remote handling engineers started preparing their component strip-out and installation procedures. Changes to the VR models representing individual components were required to be remotely and globally updated on all versions, currently in circulation, of the VR model representing the complete JET Vessel. This meant as component designs changed the engineers working on them always had the latest component models in their VR environment.

A new VR software product was identified and procured. This is VR4MAX created by Tree C Technology B.V. Starting from this off the shelf package a new bespoke VR application was developed through a collaboration between the OEM, Oxford Technologies Ltd. (OTL) and the JET remote handling group which allowed the existing JET human–machine interfaces (HMIs), which controlled the manipulators and robots both virtual and real [1] to interact with the VR environment as displayed through VR4MAX. This package is called VR4Robots.

2. Moving from CATIA configuration control model structure to VR simulation using external references

As well as improved real-time graphic performance one of the key items of new VR4Robots functionality that did not previously exist in PTC DIVISION Mockup is the software allows a new way of structuring the JET Vessel VR model using externally refer-

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[1] See the Appendix of F. Romanelli et al., Proceedings of the 22nd IAEA Fusion Energy Conference 2008, Geneva, Switzerland.

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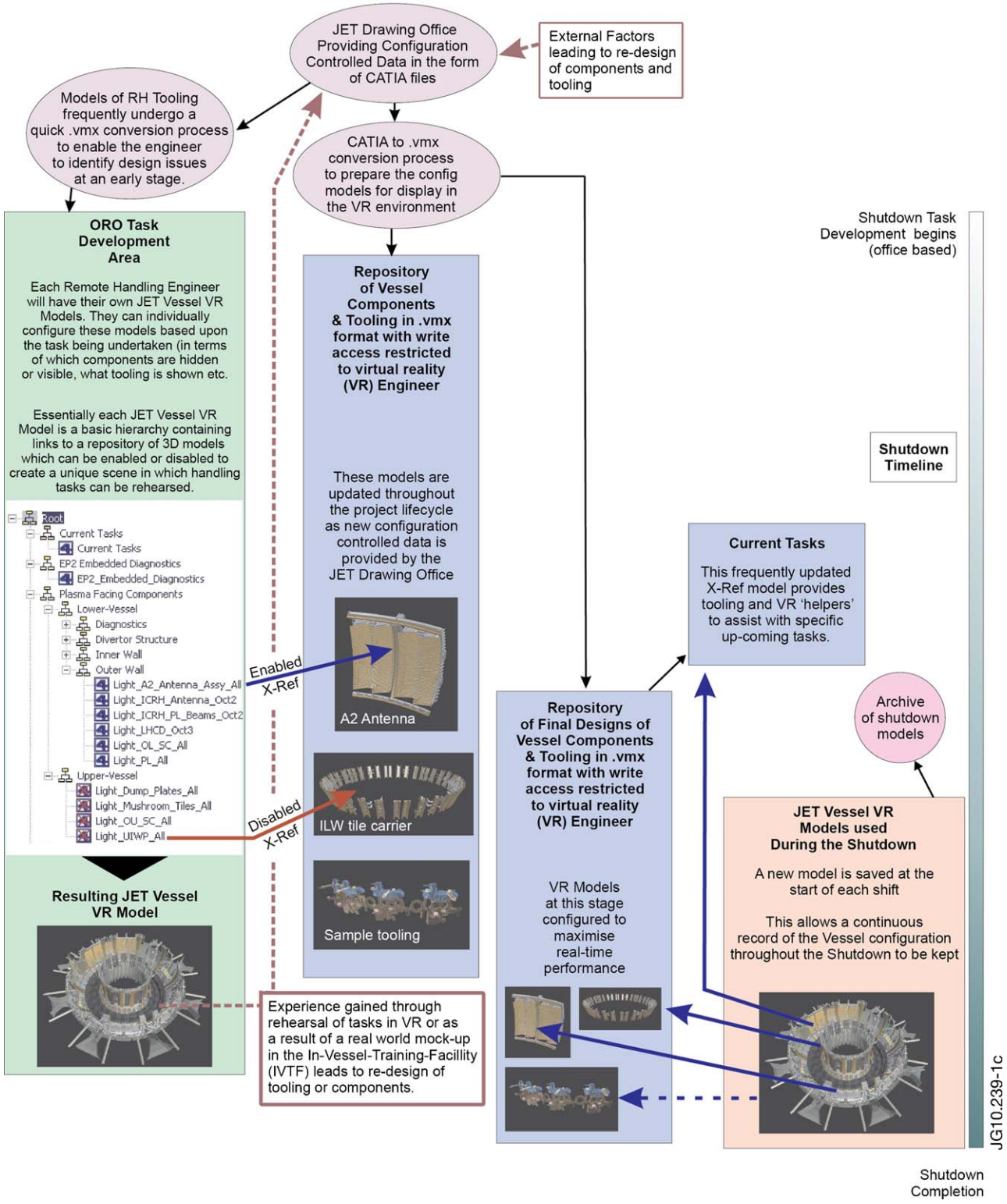

Fig. 1. Diagram illustrating the structure of the JET Vessel VR model and the use of XRefs.

enced models. This allows multiple engineers to have individually configurable VR models, that at the same time could have their constituent parts remotely updated as the design of component parts evolved. This ensured RH engineers were always rehearsing their tasks in the most up-to-date VR environment. To achieve this the master JET Vessel VR model was built as essentially a simple hierarchy containing links to numerous other 3D models; these linked models are called external references (XRefs). It is these external models that provide the true detail of the JET model. The workflow and concepts behind this new way of structuring the VR model are illustrated in Fig. 1.

For each component in the JET Vessel model (or item of tooling) there would be a 'latest release' model stored in a restricted area and controlled by a VR engineer. A copy of the master JET Vessel VR