



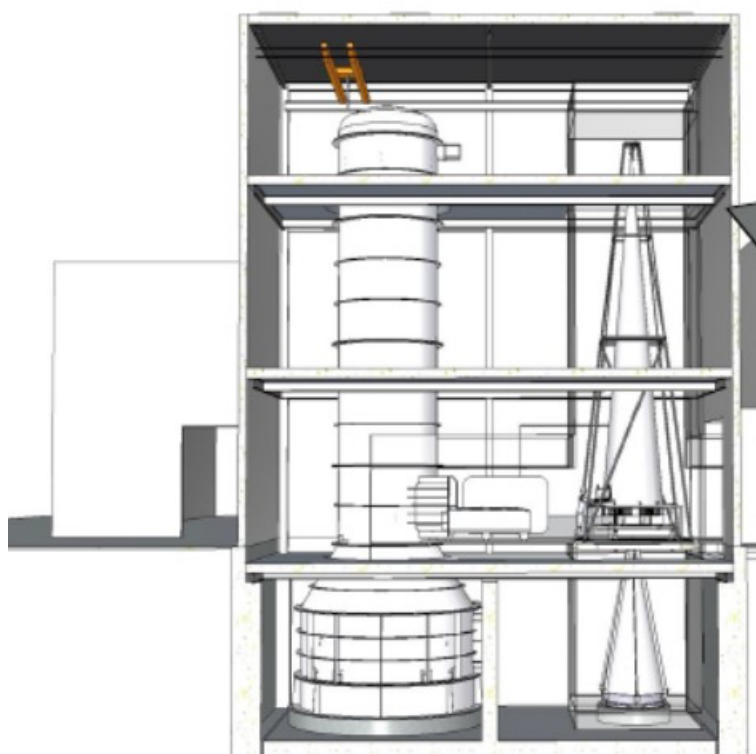
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VERT-X Design of Vertical X-Ray Test Facility for ATHENA

TN18 COST ESTIMATE FOR THE XRS FACILITY DEVELOPMENT

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1. INTRODUCTION

1.1. SCOPE

The scope of the present document is the illustration of VERT-X facility development cost estimate, following the outcomes of the Detailed Design Review (DDR) and the study activities up to the Final Review (FR).

1.2. APPLICABILITY

The present document is one of the deliverables related to the FR milestone.

It is intended to present the cost estimate for the development of VERT-X facility, providing a reference for the future studies and activities about it.

1.3. ROADMAP

Document section	Content description
Section 2 (Applicable and reference documents)	List of applicable documents and reference documents.
Section 3 (VERT-X facility development cost estimate)	Details of cost estimate for the development of VERT-X facility.

Table 1-1: Roadmap of the document

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2. APPLICABLE AND REFERENCE DOCUMENTS

2.1. APPLICABLE DOCUMENTS

AD1	AO/1-9549/18/NL/AR - SOW	X-ray Raster Scan Facility for the ATHENA Mirror Assembly SOW
AD2	VERT-INAFOAB-001	VERTICAL X-Ray (VERT-X) Technical Proposal
AD3	ESA-TECMMO-RS-014713	Updated Requirements for the ATHENA VERT-X following the System Requirements Review

2.2. REFERENCE DOCUMENTS

RD1	VTX-OAB-ISE-REP-003	D5 Detailed Design Document
RD2		

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2.3. GENERAL SPECIFICATIONS AND STANDARD DOCUMENTS

SD1	ECSS-M-40A	Configuration management
SD2	ECSS-M-50A	Information/documentation management

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2.4. LIST OF ACRONYMS

AD	Applicable Document
AIT	Assembly, Integration and Testing
DDR	Detailed Design Review
DRW	Drawing
EIE	European Industrial Engineering
ESA	European Space Agency
FR	Final Review
GPAP	GP Advanced Projects
I/F	Interface
IASF	Istituto di AstroFisica Spaziale (INAF, Milano)
INAF	Istituto Nazionale di AstroFisica
ITT	Invitation To Tender
MA	Mirror Assembly
MLS	Media Lario S.r.l.
MM	Mirror Module
OAB	Osservatorio Astronomico di Brera (INAF, Milano)
PDR	Preliminary Design Review
RD	Reference Document
ROM	Rough Order of Magnitude
RS	Raster Scan
SD	Standard Document
SOW	Statement of Work
SRR	System Requirements Review
TBA	To Be Assessed
TBC	To Be Controlled
TBD	To Be Defined
TEC	Technical Note
TVC	Thermal Vacuum Chamber
VERT-X	VERTICAL X-Ray
VTX	VERT-X
XRS	X-ray Raster Scanner
XSA	X-ray Source Assembly
XYZS	(x, y, z) stage

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3. VERT-X FACILITY DEVELOPMENT COST ESTIMATE

DESCRIPTION		COST			Status
		Phase 1	Phase 2	TOTAL	
Raster Scan		1.500.000	500.000	2.000.000	ongoing
	control system				
	X-scan		500.000		
	Y-scan				
	base				
	alt-alt mount (Tube)				
	Tip-tilt metrology				
Source + collimator		1.000.000	180.000	1.180.000	ongoing
	X-ray source (loan)	230.000	150.000	380.000	
	X-ray collimator	620.000		620.000	
	Filter wheel / Mask		30.000	30.000	ongoing
	Interfaces and Integration	50.000		150.000	
Detection system		0	800.000	800.000	ongoing
	Positioner		150.000		
	Detector (with GSE)		650.000		ongoing
GSE			450.000	450.000	
	Trolley		300.000		ongoing
	Building				ongoing
	Control system		150.000		
Laser Trackers			570.000	570.000	ongoing
TVC		0	6.680.000	6.680.000	
	Control system		70.000		
	Vacuum vessel		4.200.000		ongoing
	Vacuum pumping sys.		410.000		
	MAM Shroud		300.000		ongoing
	Thermal Control Sys.		1.700.000	TBC	ongoing
Other Costs		100000			
TOTAL		2.500.000	9.180.000	11.680.000	
Contingency				10%	
TOTAL		2.500.000		12.848.000	

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The items interfaces and integration together with other costs include all the INAF, BCV and GPAP activities in the first phase. Phase 2 X-ray source costs consist in both the final purchase and further customization of the window. The detector cost refers to the current baseline for which we had an offer meeting all the project requirements. Due to the quick development of the CMOS detector we expect that the detector cost will be much lower.

We underline that some additional costs shall be intended as tbc, namely the Thermal Control System of the vacuum chamber. Here we include into this definition not only the thermal shroud and its control unit, used to generate temperature gradients on the MAM: we refer here to the whole shroud which might be necessary to keep the inner volume of the vessel within the required value.

Its quantification requires the definition of the HVAC system of the building: if the HVAC system of the building is capable to keep the control the temperature within $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$, then the TVC would not require a thermal shroud for the stabilization.

On the other side, if the HVAC is not able to satisfy such requirement, then it is necessary to equip the vacuum vessel with a thermal shroud.

The cost for the X-scan in Phase 2 includes also every additional cost due to packing & unpacking, integration on site, final commissioning in vacuum of the entire machine.

The cost breakdown for the linear metrology was updated taking into account for the integration of the laser trackers, including their respective vacuum cases.

The cost for the trolley refers to the integrated solution which is capable to move the integrated MAM - Gravity Release – MAIS back and forth between SPO-AIT and VERT-X.

An additional column is provided to highlight those elements whose development will require a certain advancement / check during Phase1.

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