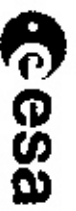




EVOLUTION OF ARIANE 5

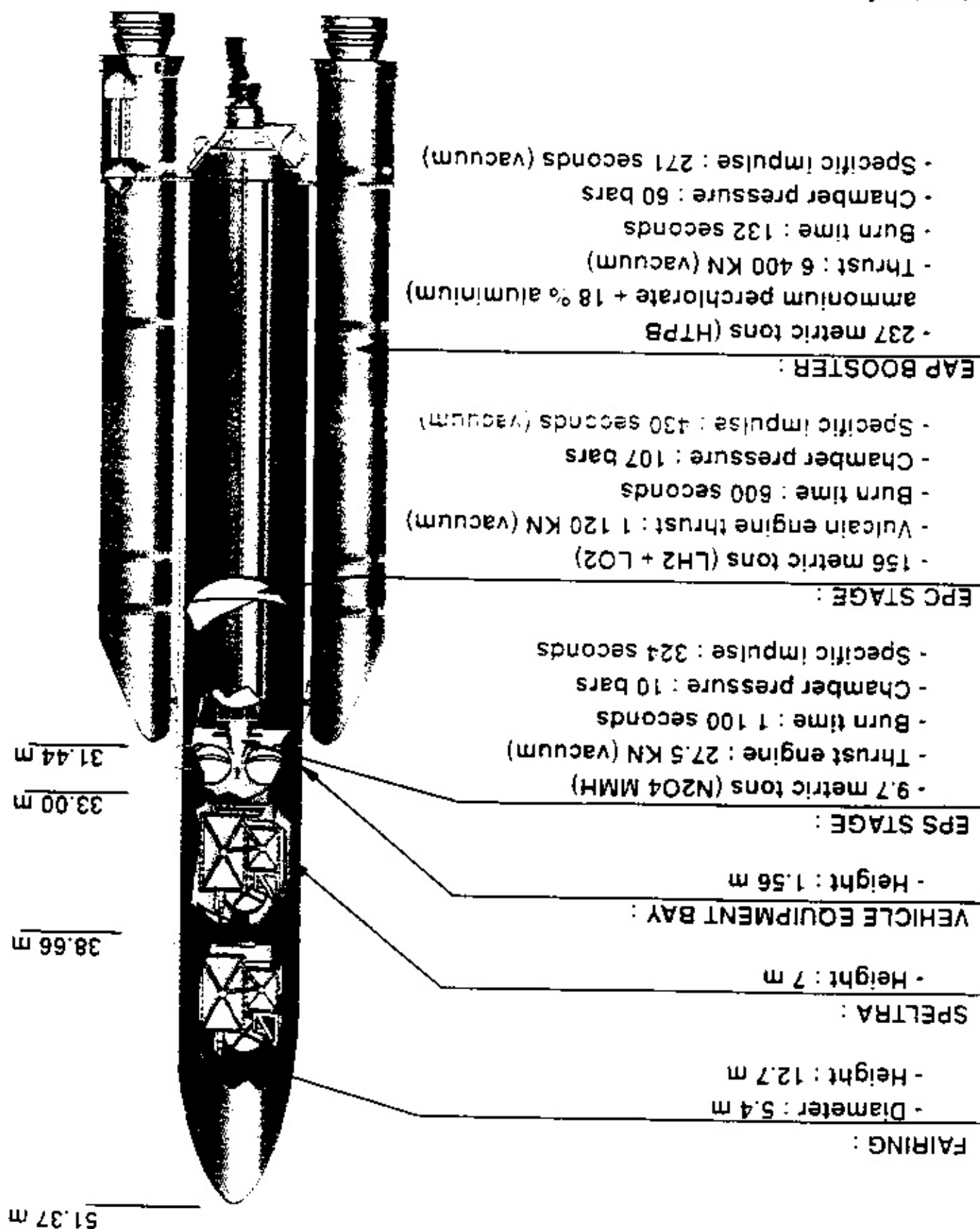
OVERVIEW

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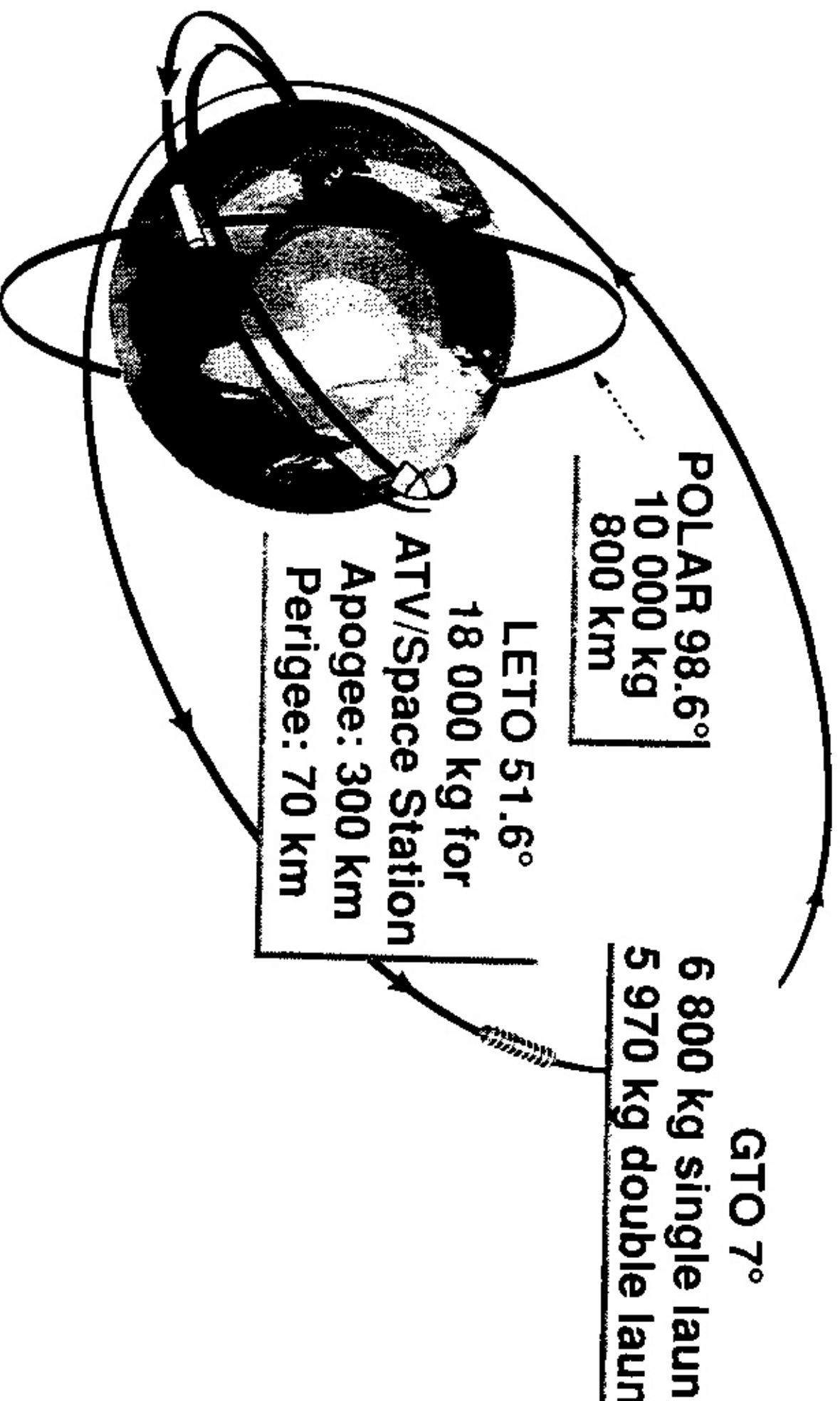
EVOLUTION OF ARIANE 5

- **Background**
 - Ariane 5 operational in 1998 (6 tons dual P/L in GTO)
 - Evolving market
 - Increase of individual GTO satellite mass
 - Constellations
 - Direct GEO injection
 - Need to cope with above market requirements
 - Maintain dual launch capability (cost reduction)
 - Widen the range of launch services
 - Answer is: Evolution of Ariane 5

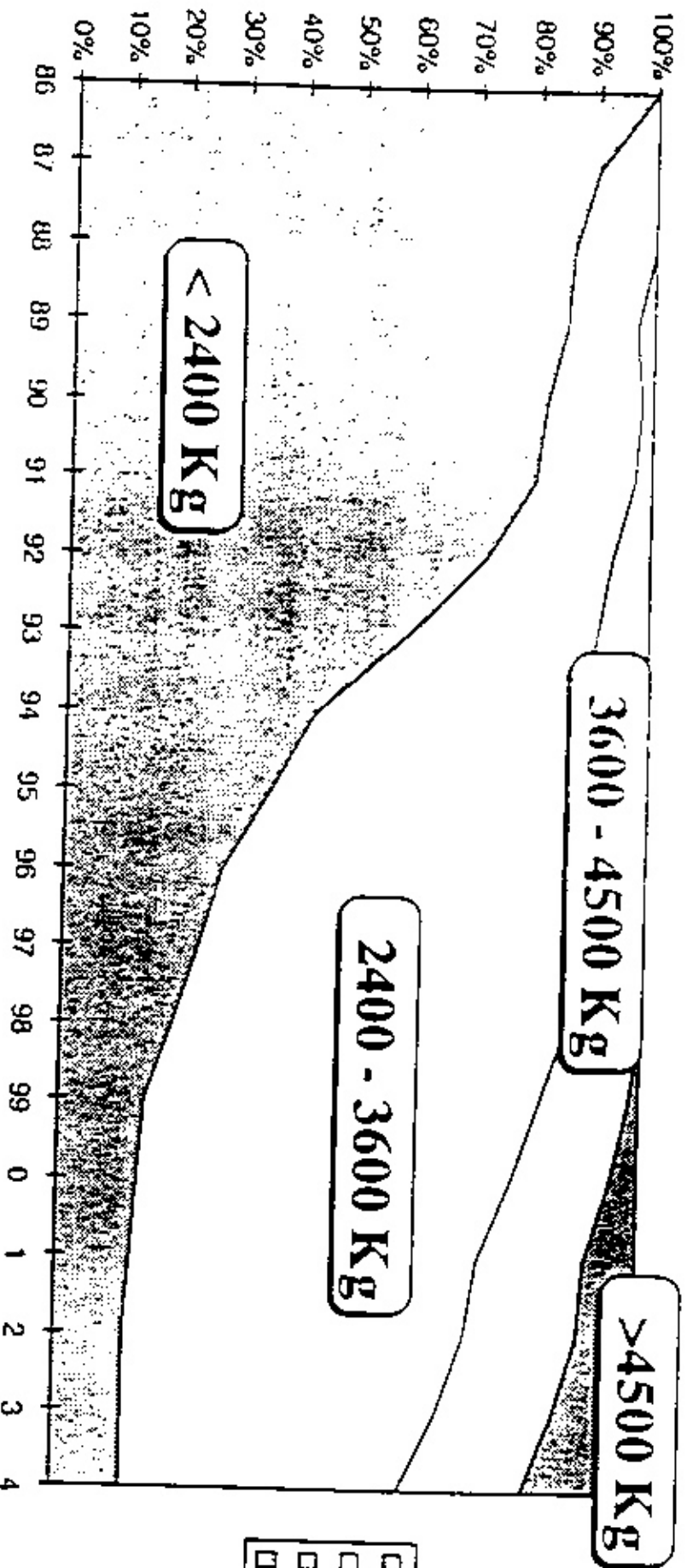




ARIANE 5 PERFORMANCE OBJECTIVES



Evolution of telecommunications satellite mass

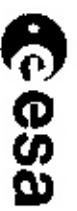


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☐ < 2400



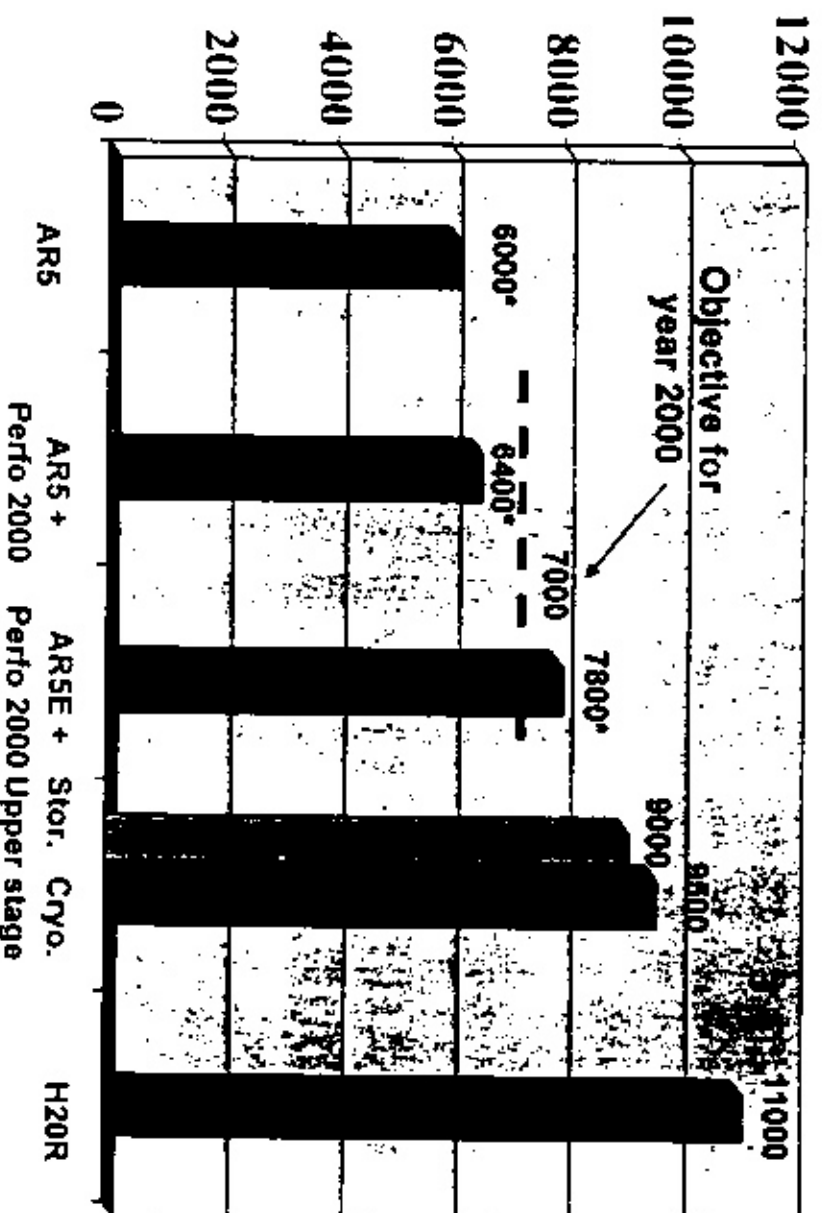
EVOLUTION OF ARIANE 5

- Scenario
 - Short term (2000)
 - AR5 performance enhancement (“Perfo 2000”)
 - AR5 “Evolution” programme
 - Versatile upper stage
 - Medium term (2003/2005)
 - Either • Storable upper stage (re-ignitable)
 - or • Cryogenic upper stage (non re-ignitable)
 - Long term (2008/2010)
 - Large re-ignitable cryogenic upper stage (H20R)



EVOLUTION OF ARIANE 5 PERFORMANCE (dual P/L launch capacity in GTO)

Dual P/L
mass (kg)

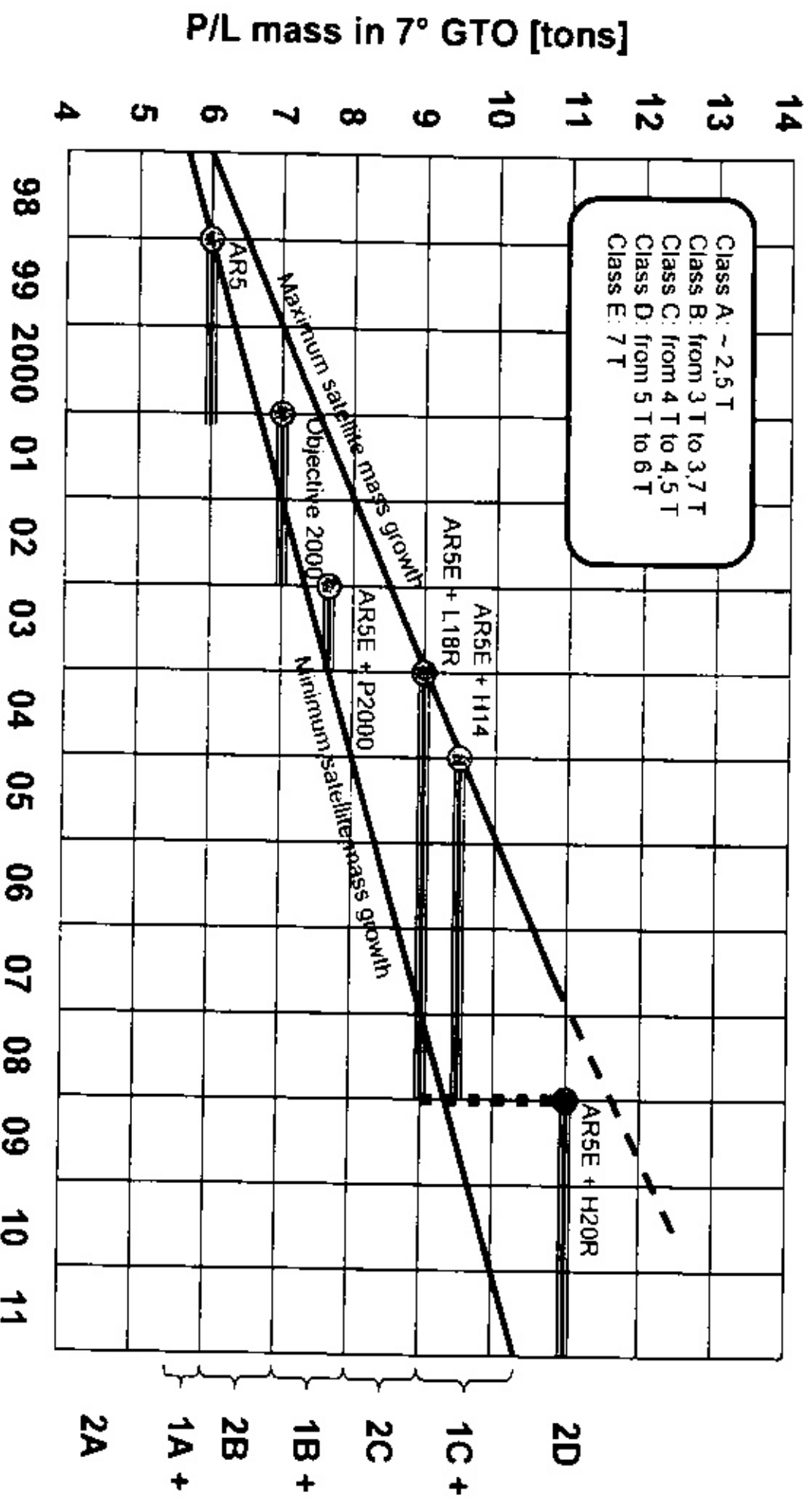


* "Versatile upper stage" (capable of ballistic phase)
would add another 170 kg

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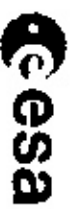


EVOLUTION OF PERFORMANCE REQUIREMENTS FOR DUAL LAUNCHES IN ARIANE 5 GTO



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SHORT TERM (1) “Performance 2000”

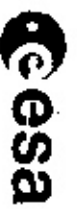
- Modifications and associated range of gain in GTO P/L mass:

• System	0/100	EPC splash down
• EPC	0/65	Vulcain setting: flow
	0/50	Vulcain setting: MR
• EAP	60/150	S1 overloading
• EPS	55/55	Nozzle lengthening
• EPS	8/20	Optimization of thermal isolation of the stage
• VEB	100/100	Change metal to carbon
• <u>VEB</u>	<u>20/20</u>	Jettisoning of SCA protectors
TOTAL	243/560	

- Average gain: 400 kg of P/L in GTO
- Status: Industry (Arianespace) investment - Under way

Note: managed by CNES; monitored by ESA

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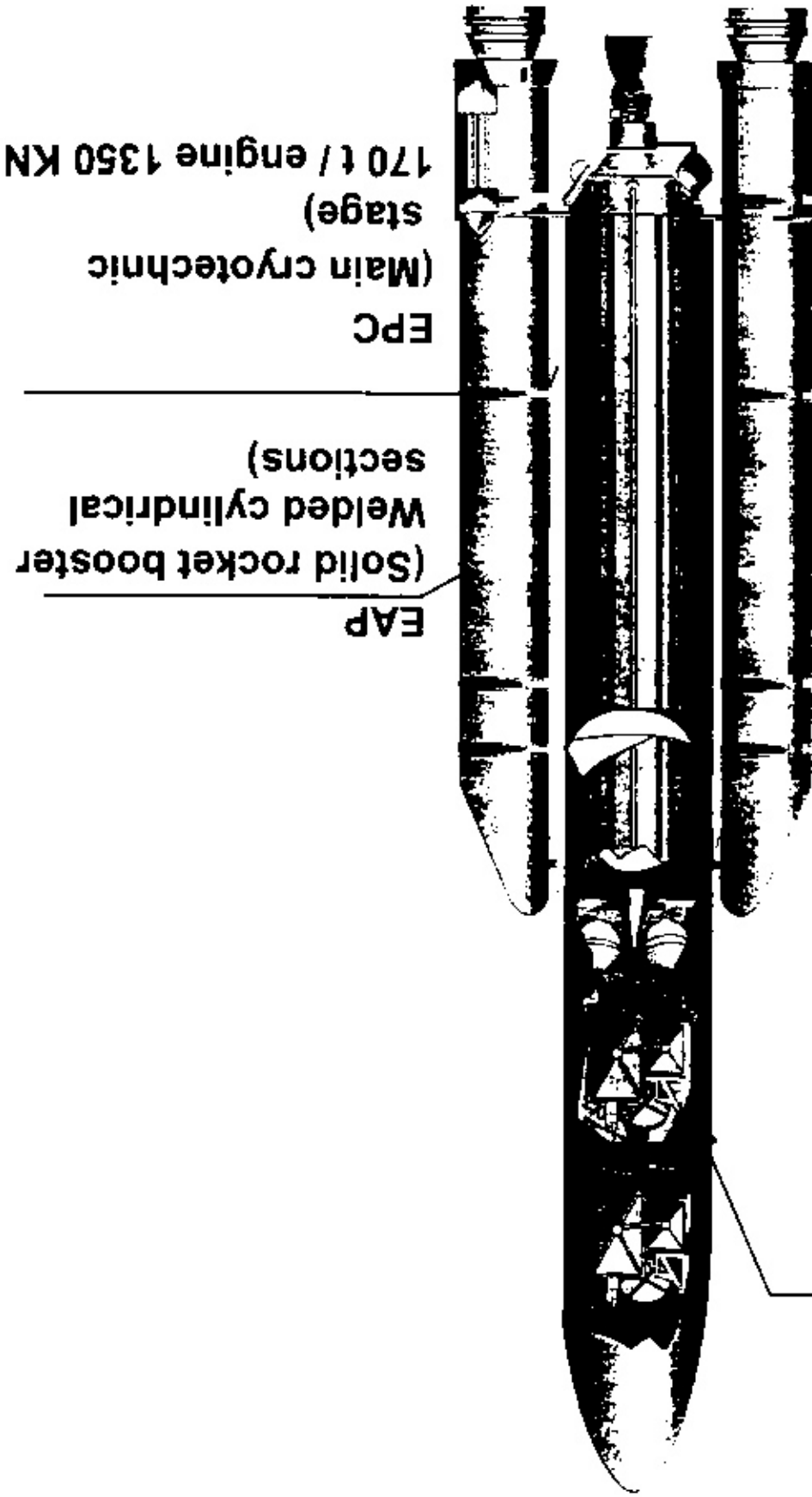
SHORT TERM (2)

Ariane 5 "Evolution" programme

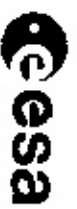
- **Objective: increase of dual launch capability up to at least 2 x 3,700 kg (7,400 kg) in GTO**
- **To be obtained by: increase of GTO performance by 1,400 kg**
- **To be achieved through 3 main modifications:**
 - Vulcain Mk II -> + 875 kg
 - Sylda 5 -> + 400 kg
 - Welded EAP casing -> + 125 kg
 - Total + 1400 kg**
- **Cost: 840 MECU 95**
- **Status: Approved ESA programme since Oct 1995**
On-going development

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SYLDA 5
(Ariane 5 carrying
structure for double
launch)

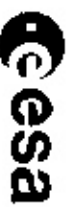


SHORT TERM (3) Versatile Upper Stage

- Objective:
 - Allow missions with long ballistic phase before upper stage ignition, or re-ignition of the upper stage
- Required for:
 - Dual launch in SSO
 - Scientific missions: Rosetta, Integral (Ariane 5 is back-up solution)
 - Performance improvement by use of a ballistic phase
 - Injection into higher energy orbits (super-GTO)
 - Constellations
- Performance gain: 170 kg (GTO)
- Changes:
 - Upper stage (thermal control, power, attitude control system etc.)
 - Vehicle equipment bay
 - Adapted ground stations (new station: Iles Marquises)
 - System impacts
- Cost (estimate): 26 MECU
- Development time: 3 years (1998-2000)
- Status: Proposal

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MEDIUM TERM Upper stage enhancements

- **Objective:** allow dual launch of a conventional satellite and a heavy satellite
- **Requirement:**
 - Maintain competitiveness from 2003 to 2007
 - Coherence with short term and long term solutions
 - Limited investments
- **Scenario 1**
 - improve existing upper stage
 - no change of the interface with the vehicle equipment bay
 - enlarged tanks (max 18t prop.)
 - Aestus engine with turbopumps
 - alternative propellants
 - re-ignitable
- **Development time: 1999-2002**
- **Performance (with A5E): 9t**
- **Scenario 2**
 - adopt a new cryogenic stage (H14) derived from the H20 (long term option)
 - use the Ariane 4 upper stage engine (HM7B) non re-ignitable
 - achieve synergy with H20 development
- **Development time: 1999-2004**
- **Performance (with A5E): 9.5 t**

Status: Industrial trade-off studies

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LONG TERM New Cryogenic Upper Stage

- Performance objective: 11 ton in GTO required for dual launch of heavy satellites of the new classes (5-6 ton)
- Solution:
 - New cryogenic upper stage (on the Ariane 5 Evolution lower composite)
 - New cryogenic expander cycle engine (re-ignitable)
- Changes required:
 - New upper stage (H20) and new engine (100 kN)
 - Large system impact:
 - Dynamic loads
 - Flight programme
 - Reinforcement of the core stage
 - Upgrade of ground infrastructure (launch pad, operations)
 - Adapted ground stations
- Availability: 2006-2008
- Status: In-house studies (ESA/CNES/Industry)