



ANGRA 1 AND 2 – ALARA PROGRAM SUCCESSES & FUTURE INITIATIVES

By: Marcos Antonio Do Amaral
Radiological Protection Manager



Eletrobras
Eletronuclear



Sítio de Angra 3 – status de construção do Edifício do Reator (foto Eletronuclear)

Brazilian Dose Limits

100 mSv / 5 years

50 mSv/single year

Administrative Limits

75 mSv / 5 years

20 mSv / single year

Angra Dose Constraints

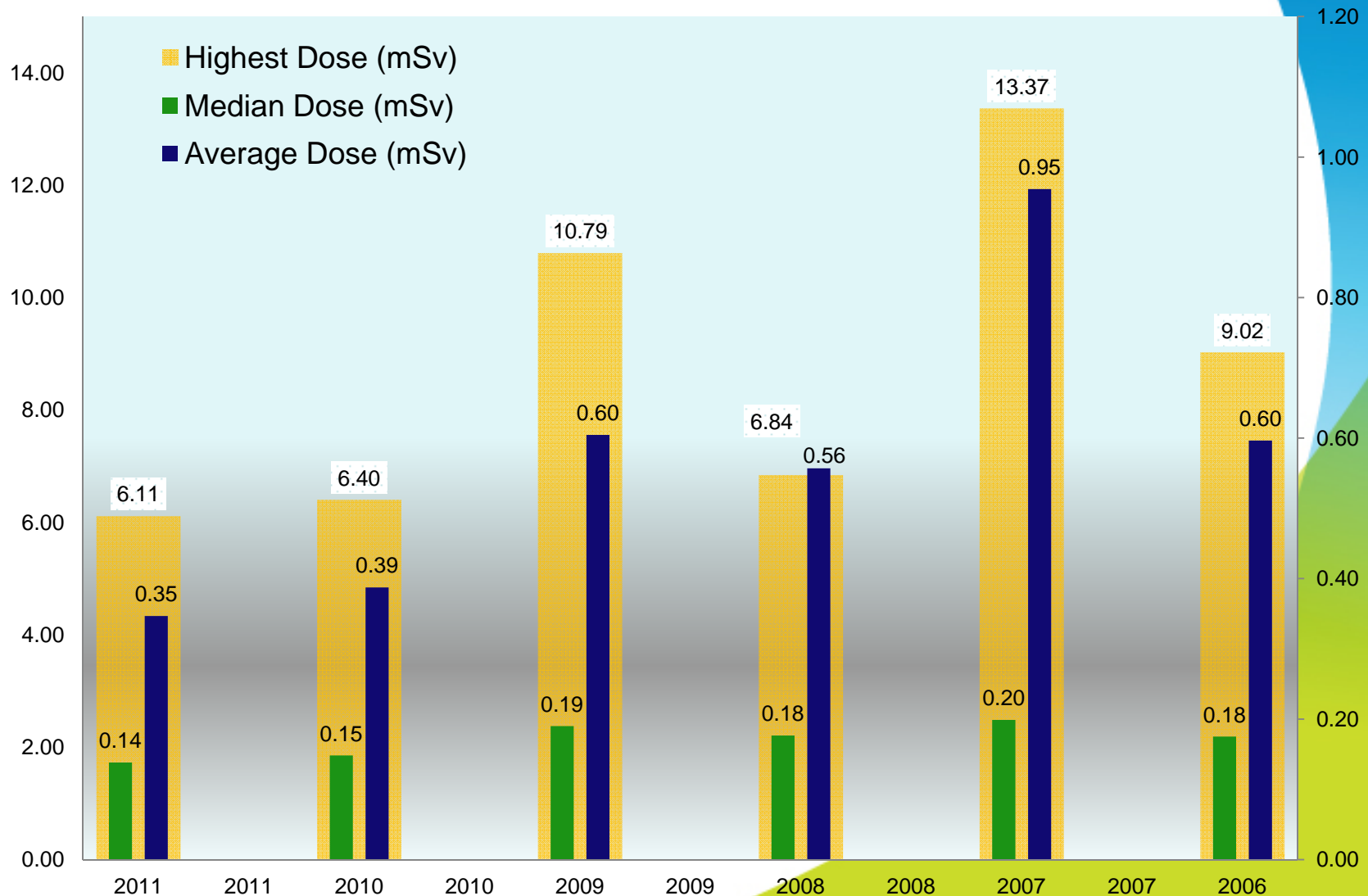
6 mSv/year

Authorized Dose Revision is required to allow higher doses.

ADR approved by the Plant Manager, RPM and with formal agreement by the radworker.

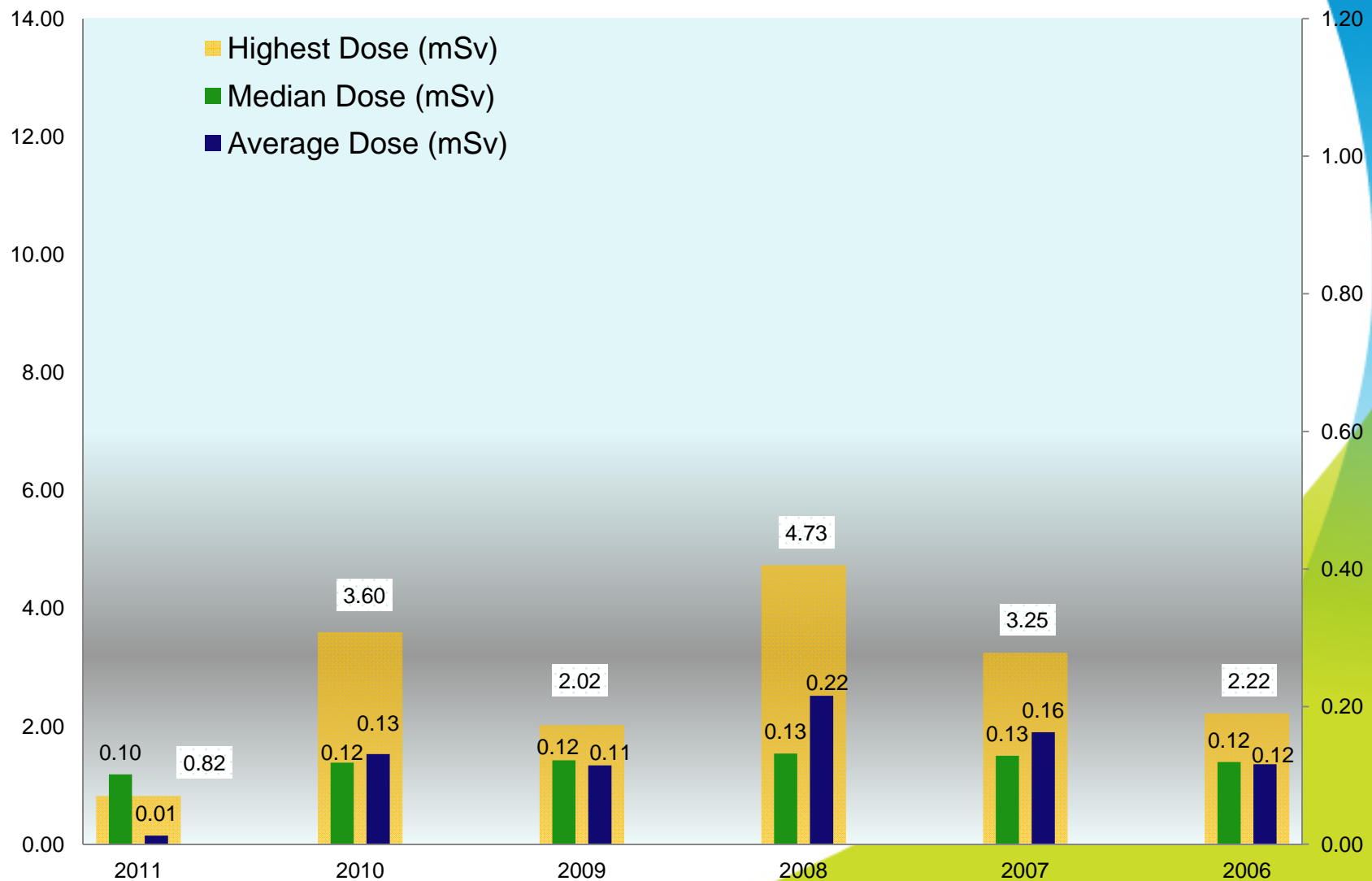
Angra 1- Doses for 2006-2011

Electronic Personal Dosimeter Distribution

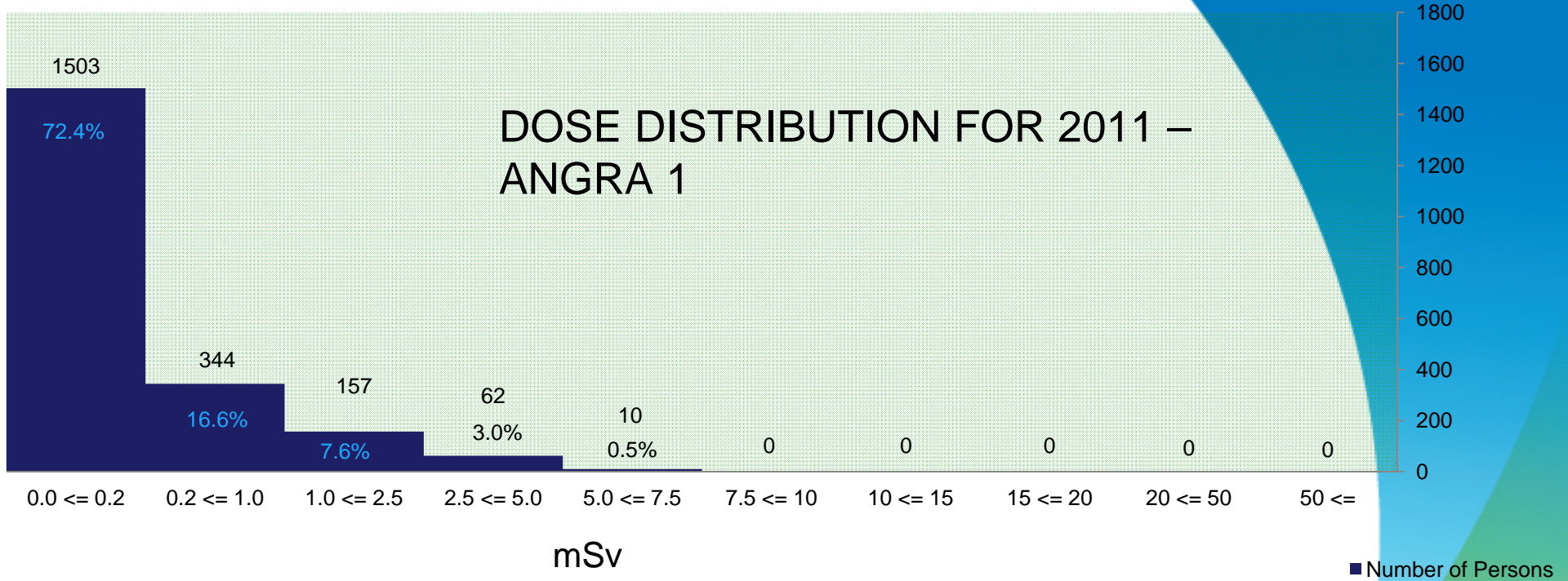


Angra 2- Doses for 2006-2011

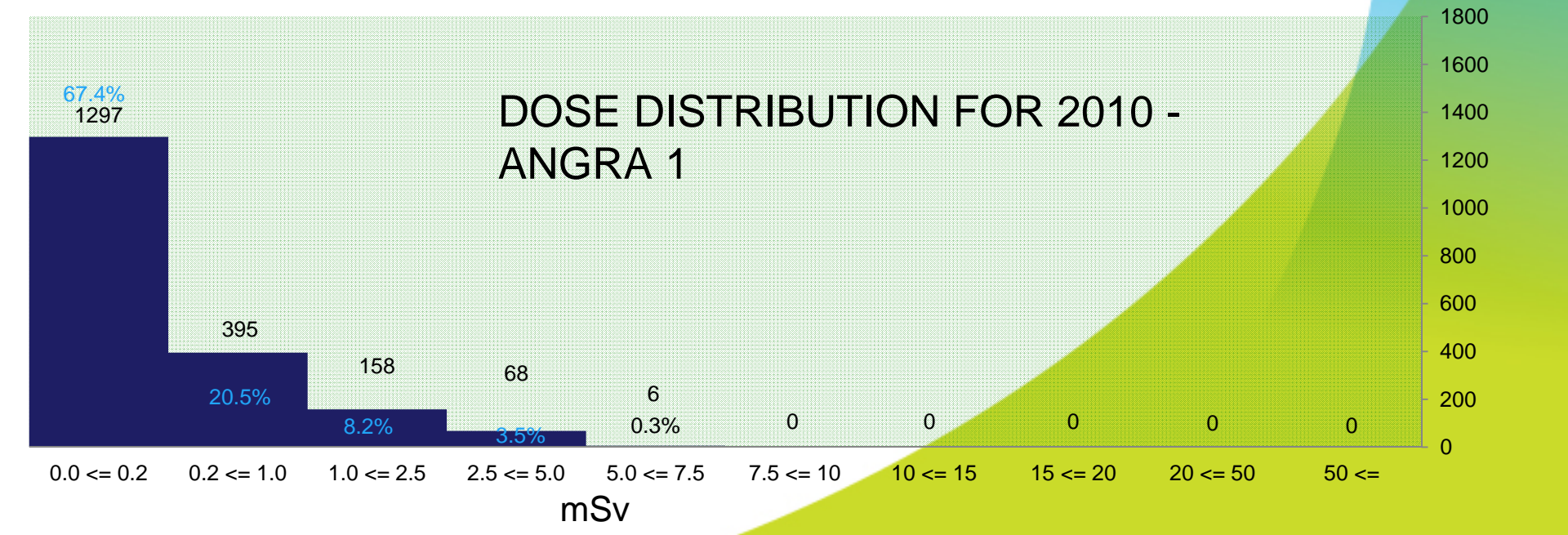
Electronic Personal Dosimeter Distribution

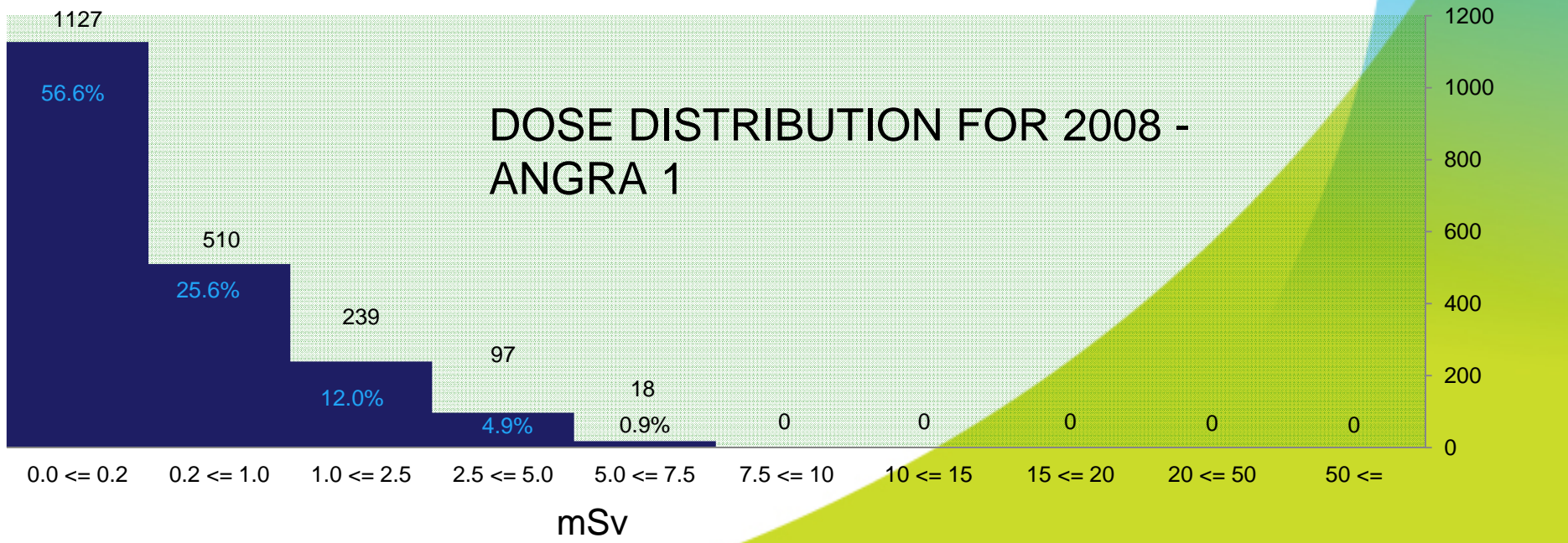
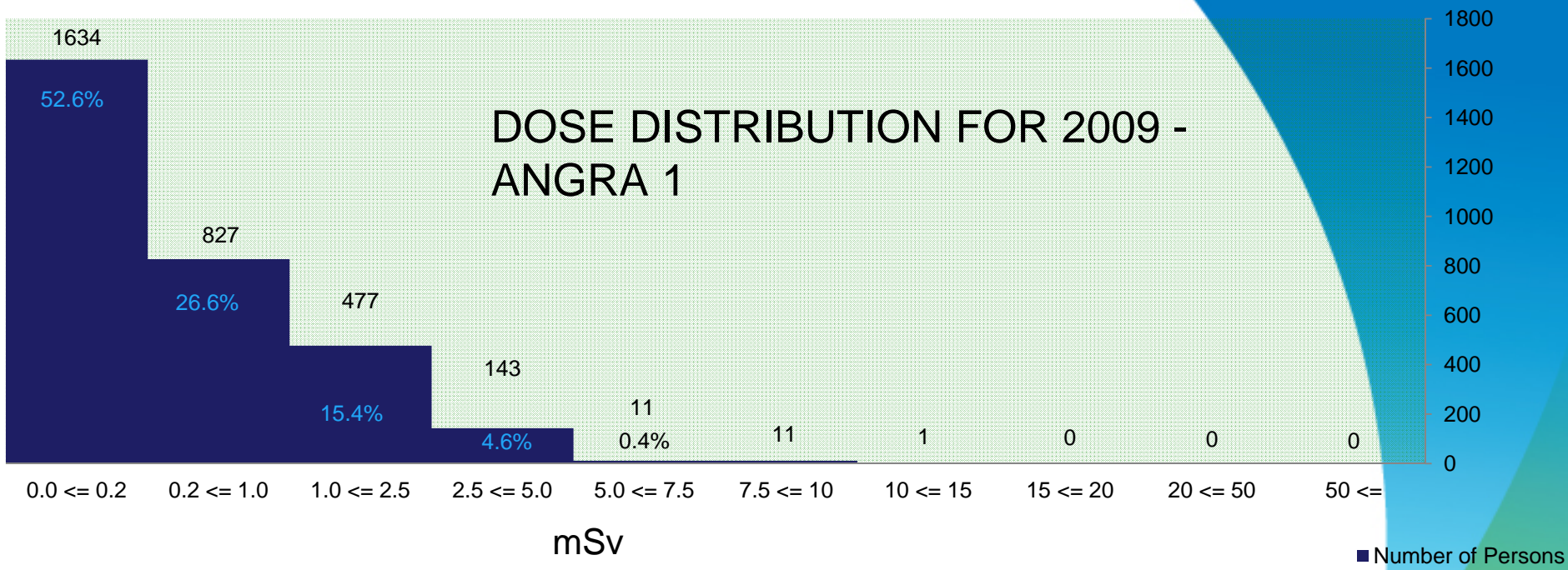


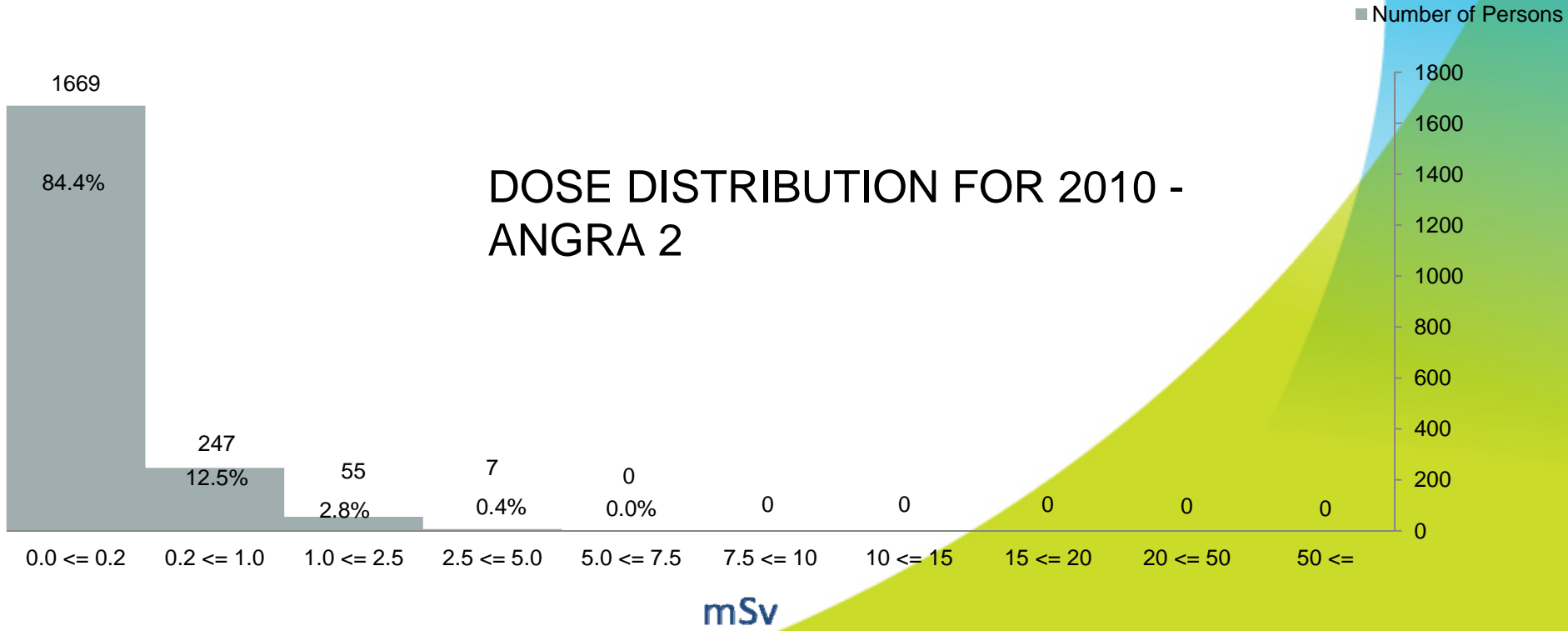
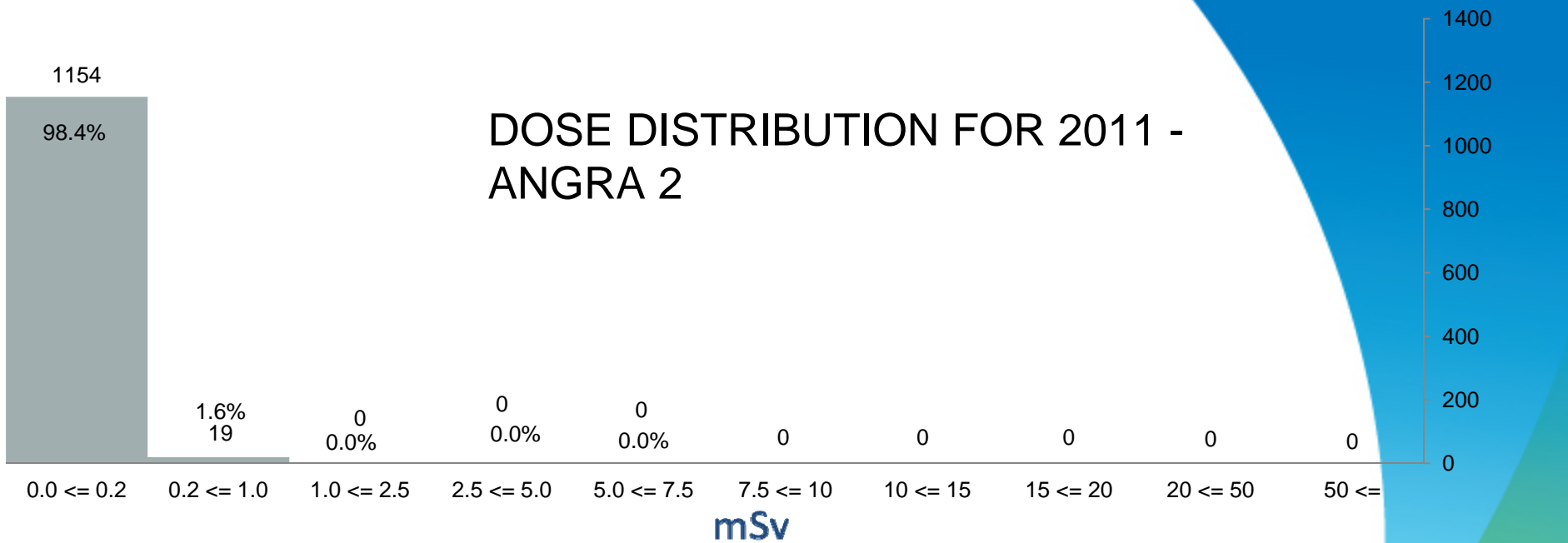
DOSE DISTRIBUTION FOR 2011 – ANGRA 1



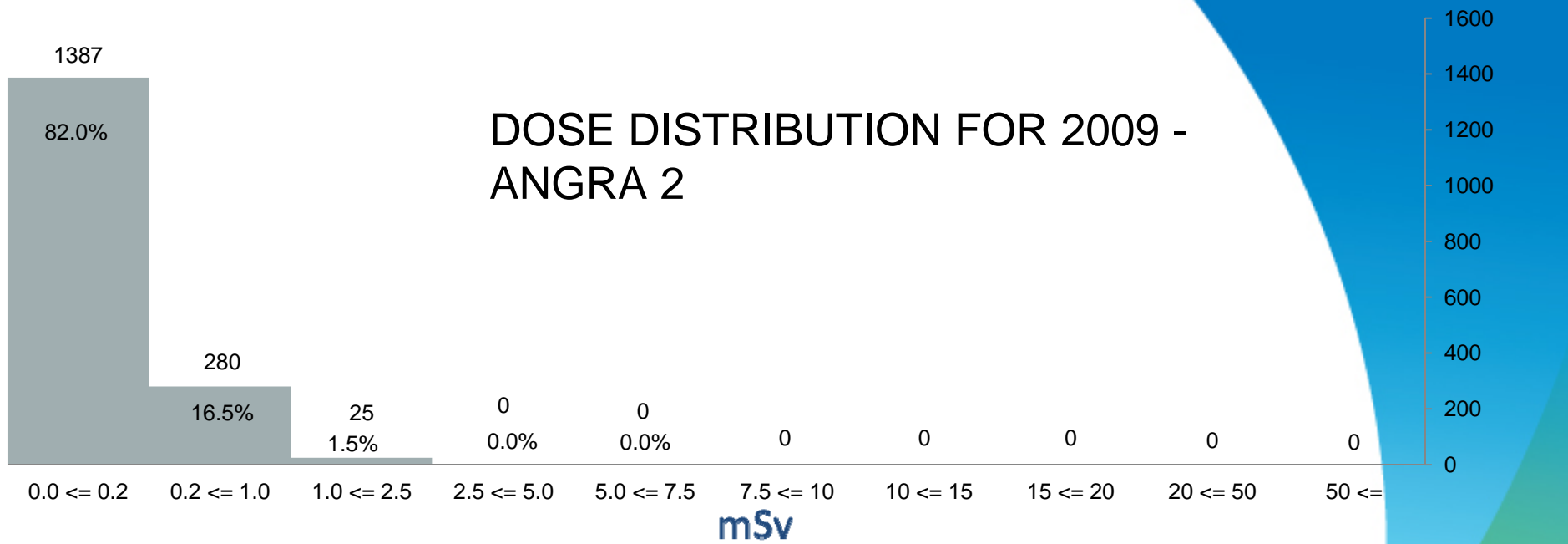
DOSE DISTRIBUTION FOR 2010 - ANGRA 1



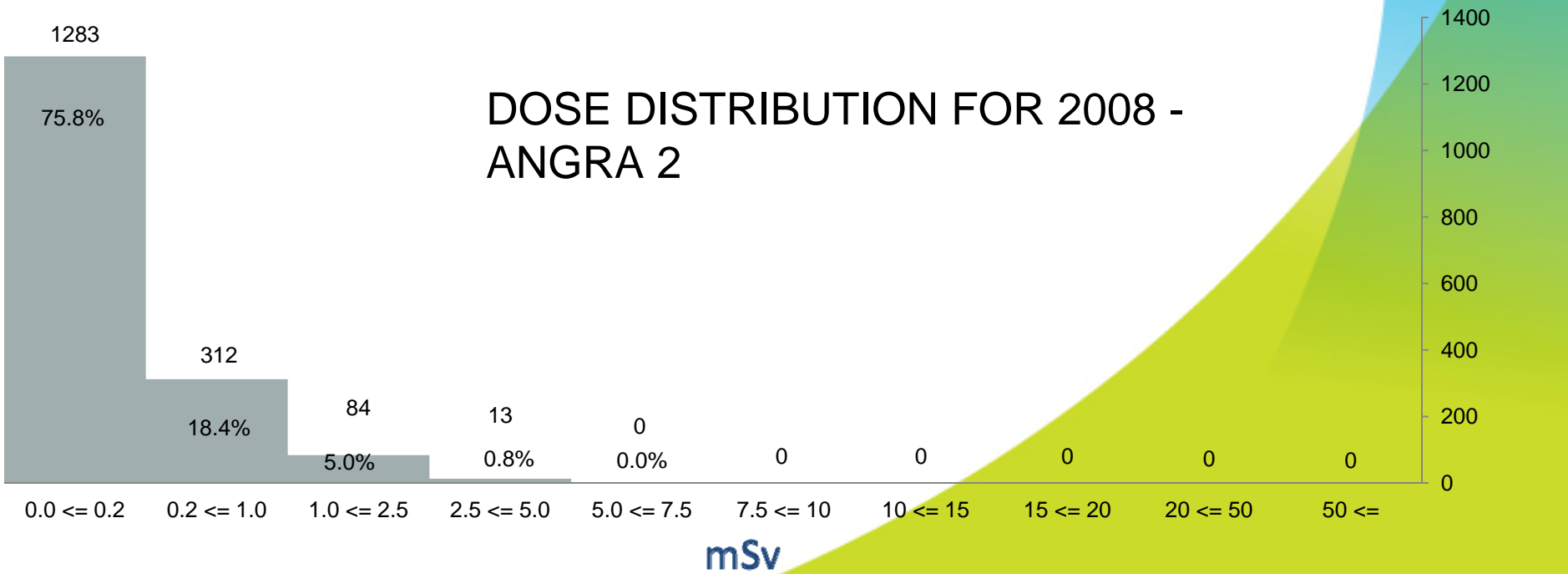




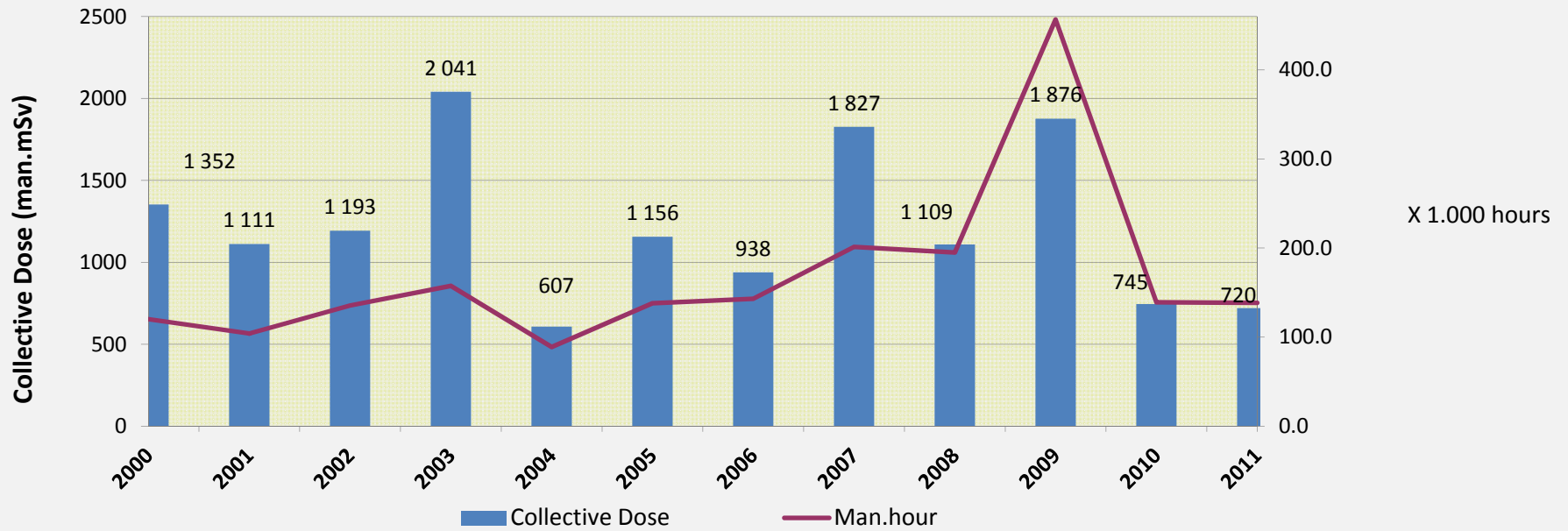
DOSE DISTRIBUTION FOR 2009 - ANGRA 2



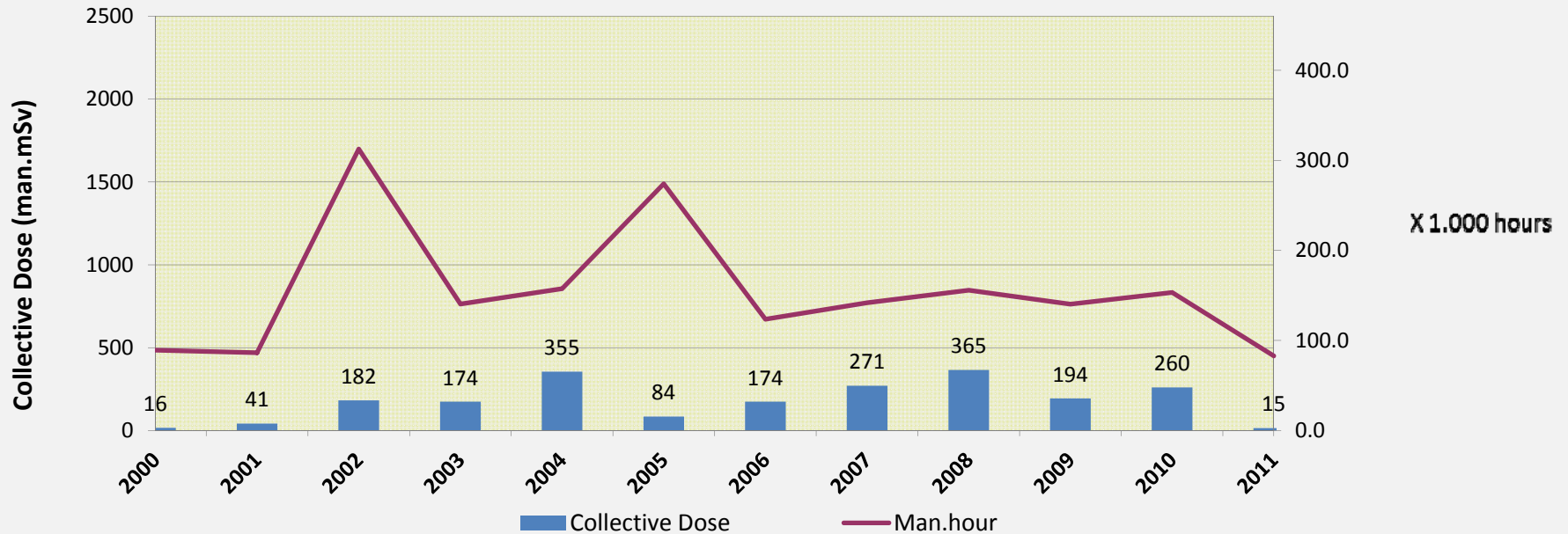
DOSE DISTRIBUTION FOR 2008 - ANGRA 2



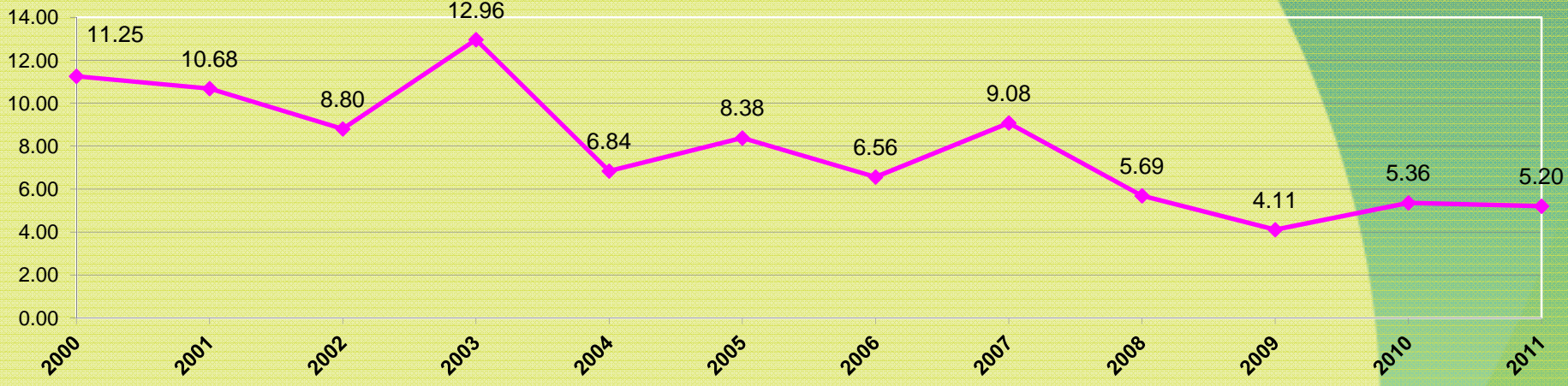
COLLECTIVE DOSES & MAN-HOUR FOR ANGRA 1



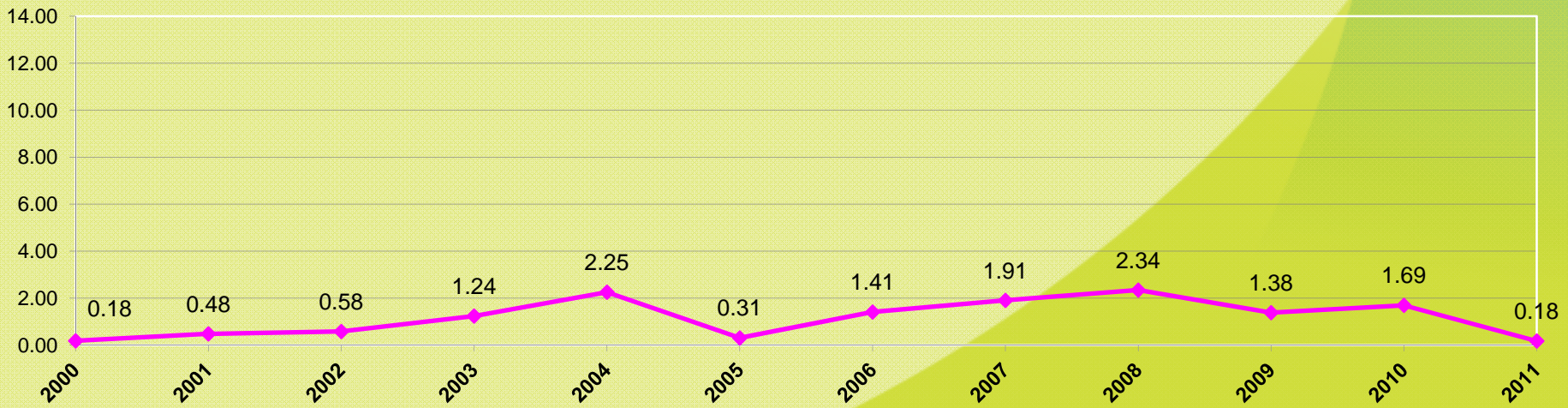
COLLECTIVE DOSES & MAN-HOUR FOR ANGRA 2



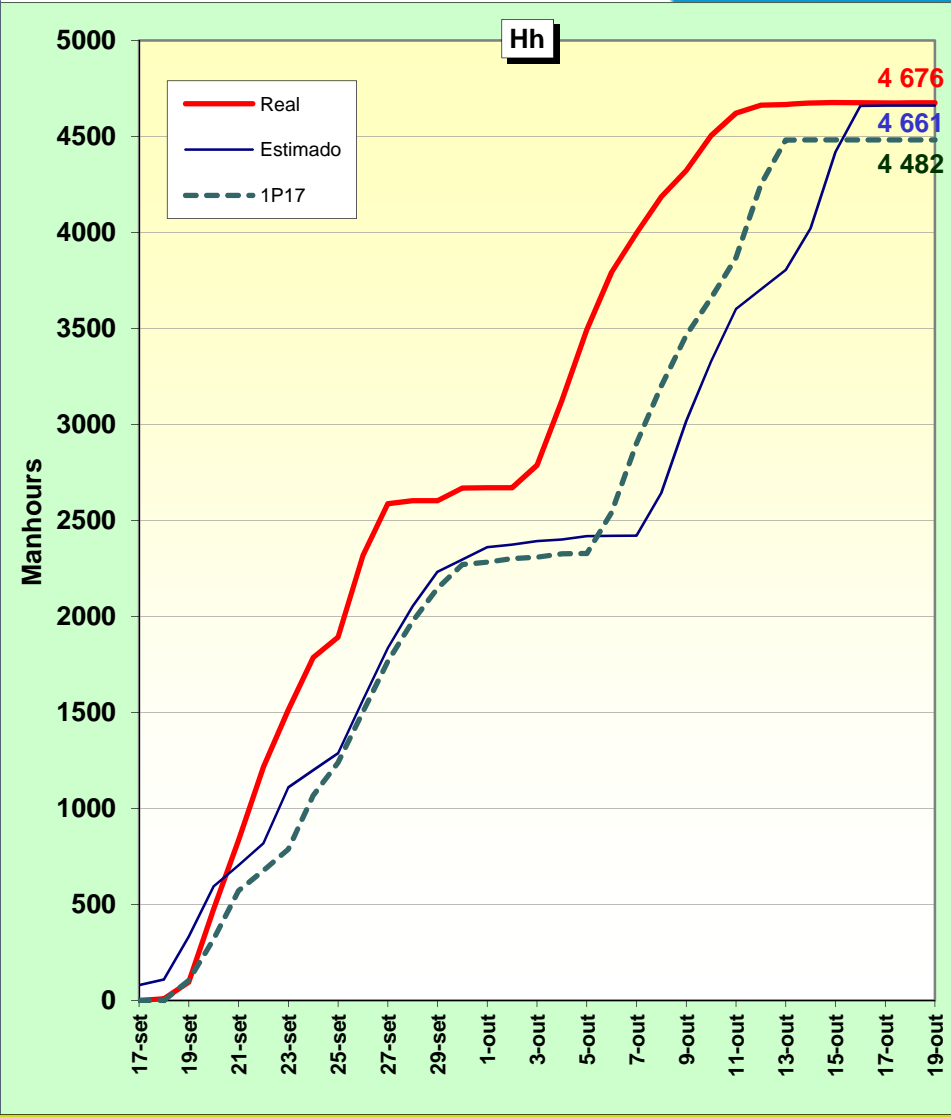
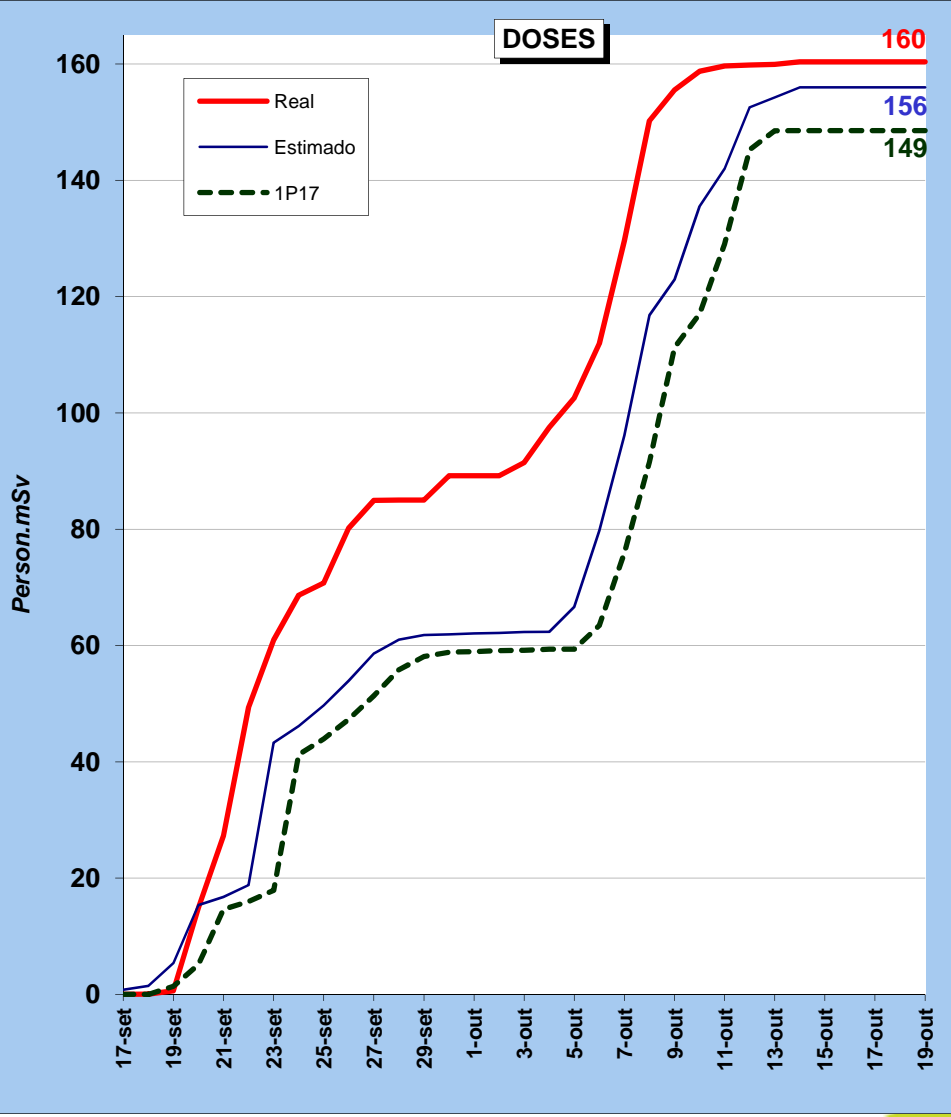
Dose Rate Index - Angra 1
($\mu\text{Sv/h}$)



Dose Rate Index - Angra 2
($\mu\text{Sv/h}$)

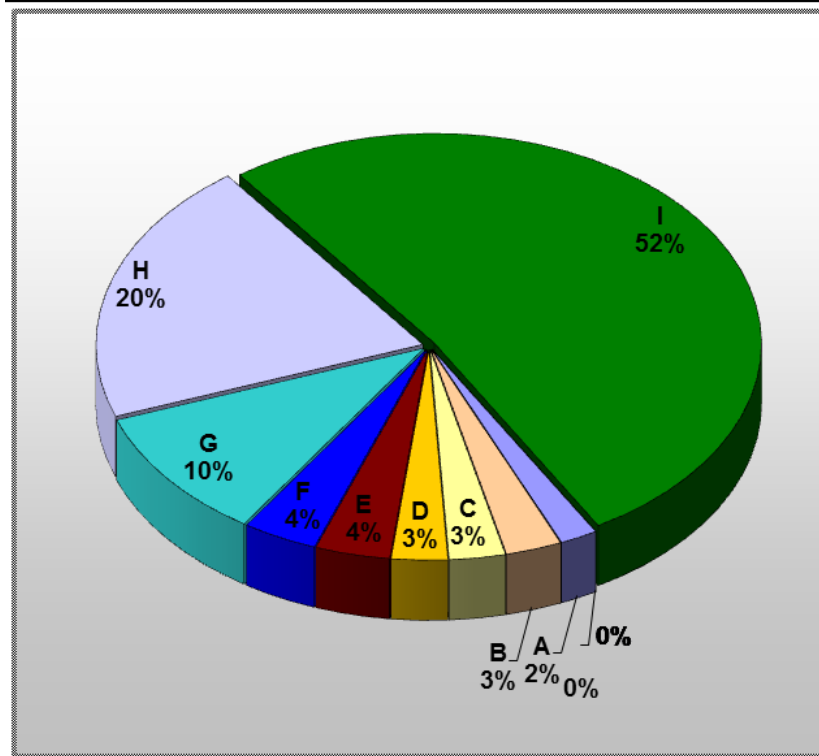


ALARA 06 – REFUELING



MINOR EVENTS CONTROL

- Each minor event is tracked and trended with online statistics in a simple excel table;
- According the degree, immediate actions and coaching are taken;
- Periodical evaluations and actions are planned;
- Very flexible tool for accounting and correcting minor events.



LEGENDA:

- A = Falha de Equipamento/Instrumento portátil da DIPR.O
- B = Alarme de dosímetro espúrio
- C = Defeito no Portal de Veículos
- D = Defeito no Portal da Saída da Área Controlada
- E = Outros
- F = Violação de Baixa Gravidade
- G = Alarme de dosímetro - Tx. De Dose
- H = Contaminação Pessoal Menor que EPRI Nivel 1
- I = Alarme em Portal S/ Contaminação em Nivel de Registro

Recent Troubles

- *Angra 1 - Poor primary coolant purification;*
- *Turnover of auxiliary manpower – competition for human resources;*
- *Angra 1 Waste Evaporator – defective tubes.*

Main Achievements

- *Completion of the Steam Generator Replacement – Angra 1;*
- *Teledosimetry and remote communications running;*
- *Human Performance Tools – Effective Communication and Pre Job Briefings – continuous process;*
- *Plant's personnel commitment for dose reduction;*
- *Definition of an empiric curve for Dose x Activity for the refueling water & validation (Angra 1);*
- *Individual & Collective Doses reduction both for Angra 1 & 2.*
- *Accreditation in 2010 of both External Dosimetry Laboratory and Radiation Instruments Calibration Laboratory – also accreditation according ISO 17025 is expected for beginning 2012.*

Next Steps

- *Personal Mobile Extension for Use Inside Containment and later in general areas;*
- *Increase the use of CCTV (40 cameras for the incoming 2P9 – Angra 2);*
- *In progress the design modification in Angra 1 for setting up a very modern CCTV/full duplex audio system;*
- *Increase the tons for tungsten and covered lead shielding.*
- *Use of robot for surveys inside high radiation areas – already assembled;*
- *Setup of a new formal source term reduction program – PDCA based – first cycle in May, 2012.*

Targets

- *Collective Dose: in line with the top performers around the world;*
- *Individual Dose: nobody receiving doses greater than 2.5 mSv (250 mRem) per year for each plant;*
- *Personal Contamination: no contamination above EPRI Level 1 and less than 1/10,000 entries inside RCA.*
- *Upgrade the RP Team for Angra 3, Fuel Elements Storage Building and for the Northeast / Southeast new plants;*
- *Preparation of Dosimetry for the national nuclear network;*
- *Formal application of the Systematic Approach to Training – SAT and maintaining Training as Top Priority for the RP organization.*