

Space Licensing: UK Perspective

Prof Richard Crowther

Science and Technology Facilities Council

Rutherford Appleton Laboratory

Oxfordshire, UK

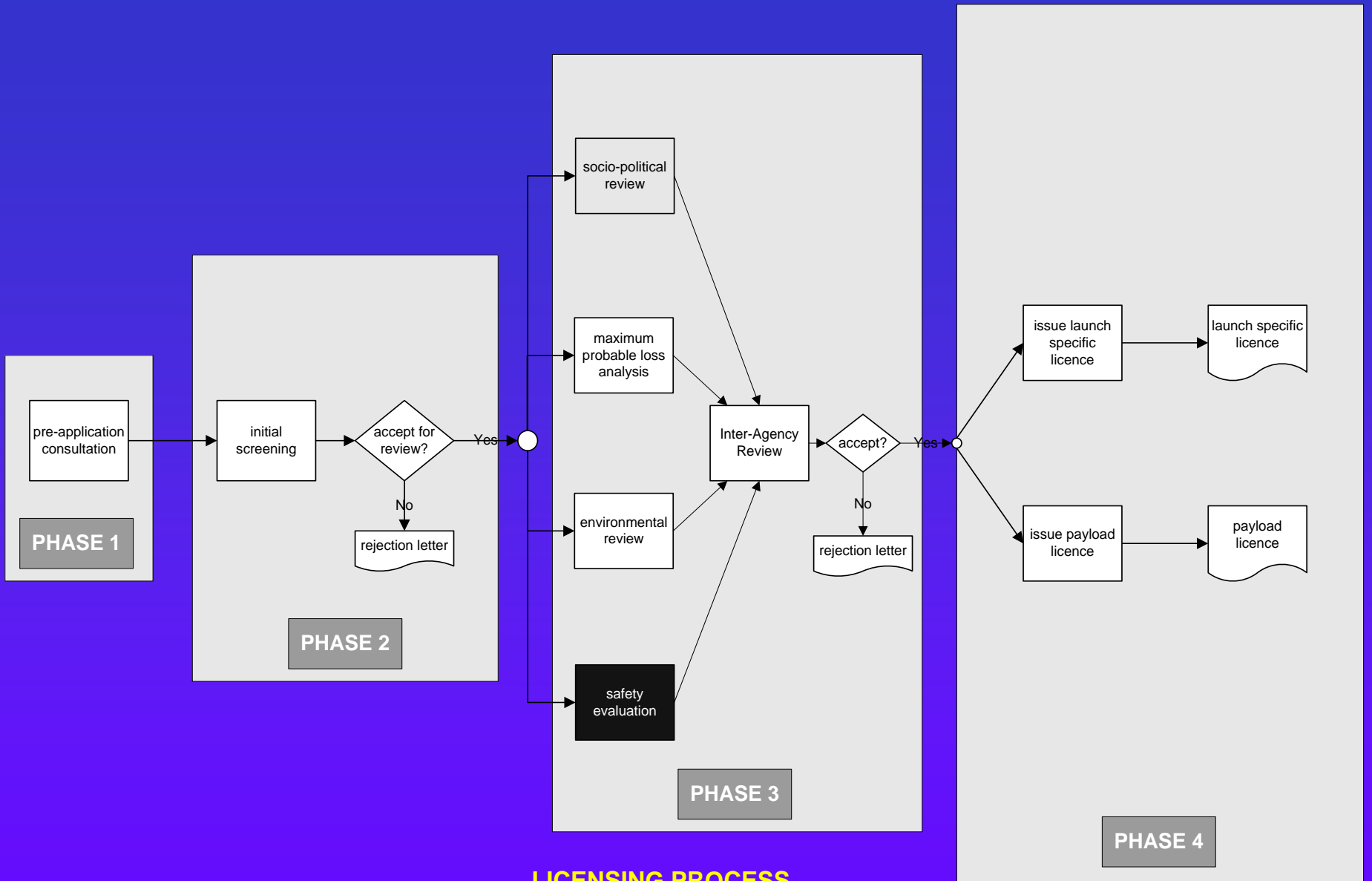


Outline

- **Space Licensing in the UK**
- **Basis for Safety Evaluation**
- **Process Approach**
- **Documentation Approach**
- **Evaluation Criteria**
- **Scenarios**
- **Lessons Learnt To Date**

Space Licensing in the UK

- **Responsibility of Secretary of State**
- **Regulatory Authority, BNSC is lead Department coordinating inputs from FCO, DIUS, MOD and others**
- **4 main phases:**
 - **1. Consultation** (is licence required?)
 - **2. Screening** (is data adequate for evaluation?)
 - **3. Evaluation** (is mission compliant?)
 - **4. Decision** (are risks adequately mitigated?)



LICENSING PROCESS



Basis for Safety Evaluation

- **Outer Space Treaty (1967)**
- **Rescue Agreement (1968)**
- **Liability Convention (1972)**
- **Registration Convention (1975)**

- **Outer Space Act (1986)**

Terms of Reference within OSA

- **‘activities ... will not jeopardise public health or the safety of persons or property’**
- **‘conduct operations ... to prevent the contamination of outer space or adverse changes to the environment’,**
- **‘avoid interference with the activities of others in the peaceful exploration and use of outer space’**

Translating OSA into Safety Requirements

- For each OSA requirement (e.g. “..prevent the contamination of outer space..”), translate into requirement for each phase of mission to be licensed (e.g. launch):
 - collision on launch avoidance
 - who performs, when, separation criteria, who decides?
 - launcher interface/ejection mechanism
 - material, debris generated, attached, orbital lifetime?
 - upper stage passivation and/or disposal
 - operational reliability, orbital lifetime, collision hazard?

'conduct operations ... to prevent the contamination of outer space or adverse changes to the environment'

LAUNCH & INJECTION

Collision on launch avoidance (COLA)

Launcher Interface/ Ejection Mechanism

Shroud/Cover Deployment

Upper Stage Disposal

Upper Stage Venting

ON STATION OPERATIONS

Calculation of miss between objects (COMBO)

Collision Risk

END OF LIFE

Disposal/ Passivation

Who Performs?
When Performed?
Criteria?

Material?
Debris generated?
Attached?
Orbital Lifetime?

Material?
Attached?
Orbital Lifetime?

Orbital Lifetime?
Operation?
Criteria?
Reliability?

Process?
Reliability?
Collision Hazard?

Process?
Performed by whom?
Criteria?
Response?

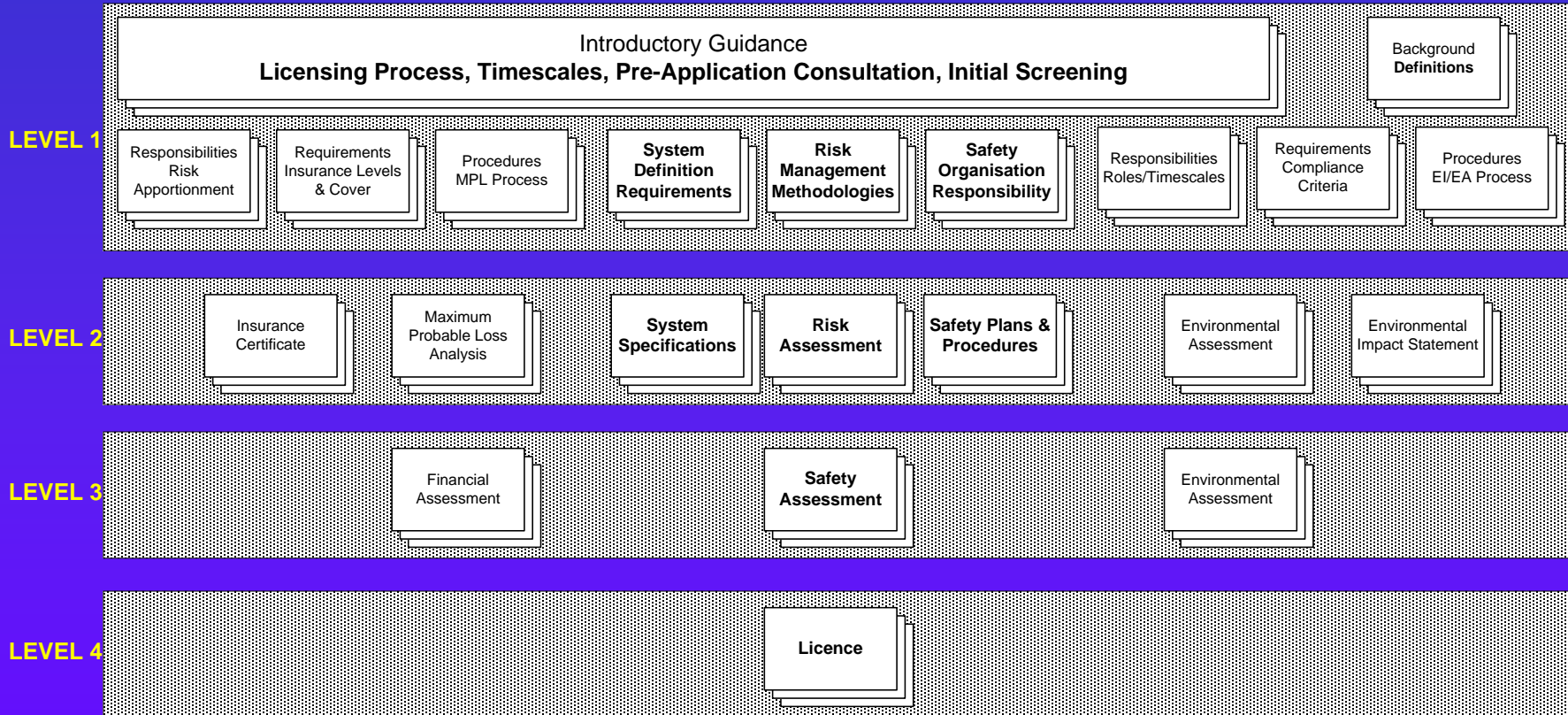
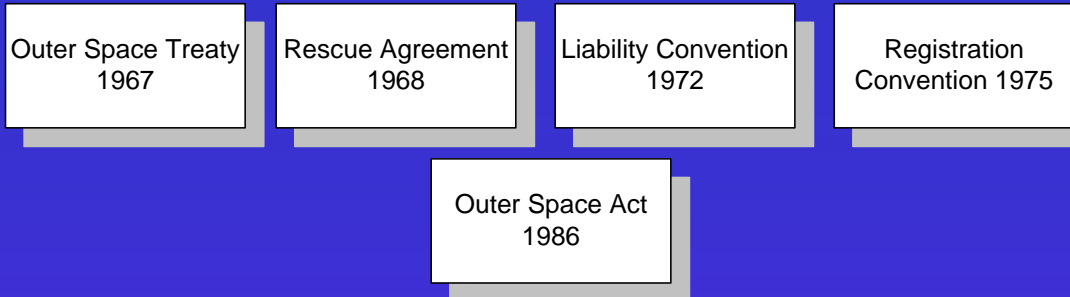
Collision risk encountered?
Collision risk represented?

Criteria?
Reliability?
Lifetime?



Documentation Approach

- **Level 1**
 - Guidance documents available to applicant
- **Level 2**
 - Data submissions made by applicant
- **Level 3**
 - Assessment documents based on submitted data
- **Level 4**
 - Notification of outcome (and licence)
- **Clear audit trail between criteria, mission spec., evaluation, and decision**



LICENCING DOCUMENTATION HIERARCHY



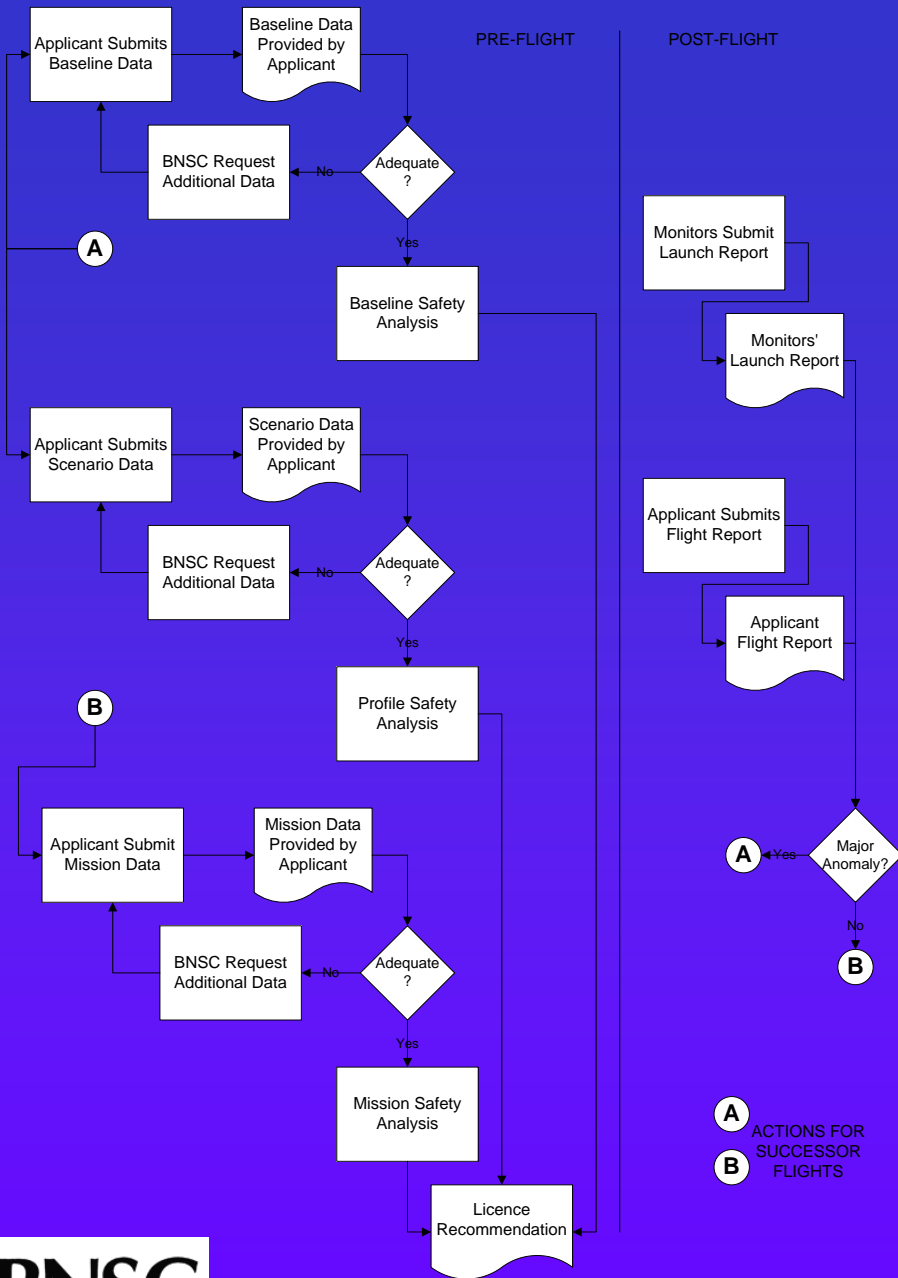
Criteria for Evaluation

- **Best Practice (Qualitative and Quantitative)**
 - International
 - European
 - National (UK, e.g. MOD)
 - National (Other state, e.g. US FAA)
- **Standards**
 - ISO/ECSS/PSS/BSI
- **Guidelines**
 - UN/IADC/ESA/NASA

WP	ESTIMATED EFFORT ACTIVITY	WEEK 1					WEEK 2					WEEK 3					WEEK 4				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	FLIGHT SAFETY SYSTEM																				
3.1.1.9	Establish details																				
3.2.1.9	Judge quality																				
3.3.1.9	Check consistency																				
3.4.1.9	Consider effectiveness																				
3.5.1.9	Establish conformance																				
	QUAL/ACCEPT. TESTING																				
3.1.1.10	Establish details																				
3.2.1.10	Judge quality																				
3.3.1.10	Check consistency																				
3.4.1.10	Consider effectiveness																				
3.5.1.10	Establish conformance																				
	FLIGHT TESTS																				
3.1.1.11	Establish details																				
3.2.1.11	Judge quality																				
3.3.1.11	Check consistency																				
3.4.1.11	Consider effectiveness																				
3.5.1.11	Establish conformance																				
	RELIABILITY ESTIMATES																				
3.1.1.12	Establish details																				
3.2.1.12	Judge quality																				
3.3.1.12	Check consistency																				
3.4.1.12	Consider effectiveness																				
3.5.1.12	Establish conformance																				
	PRE-LAUNCH RISKS																				
3.1.1.13	Establish details																				
3.2.1.13	Judge quality																				
3.3.1.13	Check consistency																				
3.4.1.13	Consider effectiveness																				
3.5.1.13	Establish conformance																				
	FLIGHT RISKS																				
3.1.1.14	Establish details																				
3.2.1.14	Judge quality																				
3.3.1.14	Check consistency																				
3.4.1.14	Consider effectiveness																				
3.5.1.14	Establish conformance																				
	ORBITAL RISKS																				
3.1.1.15	Establish details																				
3.2.1.15	Judge quality																				
3.3.1.15	Check consistency																				
3.4.1.15	Consider effectiveness																				
3.5.1.15	Establish conformance																				
	RE-ENTRY RISKS																				
3.1.1.16	Establish details																				
3.2.1.16	Judge quality																				
3.3.1.16	Check consistency																				
3.4.1.16	Consider effectiveness																				
3.5.1.16	Establish conformance																				

Use of Scenarios To Streamline Process

- High cost of licence assessment
- Repeat applications tend to use same information so need process to re-use data if possible & use exception reporting
- Use Scenario Approach
 - Baseline: first flight of vehicle
 - Profile: first flight for particular profile/derivative
 - Mission: repeat of previously successful profile



	BASELINE	PROFILE	MISSION
GEO1	✓		
GEO2		✓	
MEO1		✓	
GEO3			✓
MEO2			✓
GEO3			✓
LEO1		✓	ANOMALY
GEO4	✓		

A ACTIONS FOR SUCCESSOR FLIGHTS
B ACTIONS FOR SUCCESSOR FLIGHTS



Some UK registry objects:

- **Skynet 1A**
 - Launch 22 November 1969
 - Non-operational, stable at 105° W
- **Skynet 4B**
 - Launch 11 December 1988
 - Non-operational, 150 km above GEO
- **Europe*Star 1**
 - Launch 29 October 2000
 - Operated by PanAmSat Europe October 2005
 - Renamed Intelsat 12 Feb 2007
- **Skynet 5A**
 - Launch 11 March 2007
 - Operational

Lessons Learnt to Date

- **Access to detailed technical data difficult**
- **Documentary rather than physical evidence often only practicable solution**
- **Time scales can be very challenging**
- **Need for international standards (particularly for in orbit activities)**
- **Review activities can be resource intensive**
- **3-6 months timeframe is reasonable and realistic for launch licence applications**