

The first thirty sols: move from landing to a stable base

Guiding question

Concrete → interfaces → measurement → calculation → failure → recovery.

Course map

Mission brief → System map → Data and assumptions → Governing relationship → Starting calculations

1 — Mission brief

Plan activation, inspection, power, water, communications and refuge zones before expansion.

This capstone mission requires several modules at once. An answer is complete only when it closes physical budgets, describes sensors and actions, retains margin, handles a credible failure and explains what the crew must do. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

2 — System map

Start by drawing mass, energy, information and authority flows. An arrow without a unit or owner is incomplete. The map is then used to identify common dependencies and interfaces that can propagate failure. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

The first thirty sols are organized as a commissioning campaign rather than a sequence of opportunistic EVAs. The map separates functions qualified before arrival, connections that must be made on Mars, and equipment that should not be activated before verification. The first objective is a durable safe state: power, atmosphere, communications, water, refuge and diagnostic capability before industrial or science throughput is increased.

Equation - evidence - decision

couverture = stock / consommation

Failure to test: Check air, water, thermal control, radiation, food, medicine and workload where relevant to this mission. The goal is to avoid a false “all good” technical calculation that forgets sleep time, suit donning or the need for a second crewmember during a critical operation. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

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3 — Data and assumptions

The supplied numbers are training-scenario data. Copy them with units, add missing assumptions and separately mark values that come from NASA sources. Any value that changes the verdict requires sensitivity analysis. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

The scenario defines an activation order with transition criteria. A utility network, for example, is not declared operational until isolation, load and return-to-safe tests are complete. This prevents the common mistake of counting hardware as available as soon as it is physically connected. Each step must generate evidence that remains understandable to the next shift.

4 — Governing relationship

The equation is only an entry point. It must be connected to a budget, an available measurement and a decision threshold. If units do not reduce correctly, stop before using a calculator. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

5 — Starting calculations

Eau $2\,400\text{ L} \div 80\text{ L/sol} = 30\text{ sols}$ Interpret the result inside the global budget before making a decision.

Énergie de nuit $18\text{ kW} \times 12\text{ h} = 216\text{ kWh}$ Interpret the result inside the global budget before making a decision.

Inspection $6\text{ zones} \times 45\text{ min} = 270\text{ min} = 4,5\text{ h}$ Interpret the result inside the global budget before making a decision.

6 — Mass, power and time budget

Build three separate tables. The mass budget distinguishes structure, consumables, spares and margin. The energy budget separates instantaneous power from accumulated energy. The time budget includes operations, maintenance, rest and communications delay. Positive margin in one table does not automatically compensate for a deficit in another. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

Operational table

Phenomena / sections:	3 — Data and assumptions ; 4 — Governing relationship ; 5 — Starting calculations
Relationship to revisit:	couverture = stock / consommation
Expected decision:	measure → compare with margin → choose nominal, degraded or stop

Check before continuing

Explain without rereading: 3 — Data and assumptions ; 4 — Governing relationship ; 5 — Starting calculations. State one measured quantity, one margin and one possible decision.

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A 2,400-litre inventory provides thirty sols at 80 litres per sol in the scenario, but the division should not hide priorities and losses. The student separates life-critical use, hygiene, maintenance and contingency reserve, then defines an ISRU-start threshold. Starting too late consumes stored margin; starting too early can divert power and crew hours from base stabilization.

7 — Navigation, communications and state knowledge

State which variables must be known locally, which can be reconstructed later by Earth, and what accuracy each decision requires. Radio delay means safing and initial diagnosis must be possible without waiting for Earth. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

State knowledge should be visible in a simple local control view: available power, electrical branch state, volume pressure, inventories, open alarms and communications configuration. Earth receives logs and advises, but the crew must be able to isolate a branch or postpone activation locally. The exercise requires naming who holds authority for those decisions during early surface operations.

8 — Survival and human factors

Check air, water, thermal control, radiation, food, medicine and workload where relevant to this mission. The goal is to avoid a false “all good” technical calculation that forgets sleep time, suit donning or the need for a second crewmember during a critical operation. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

Workload includes acclimation and operational overhead. Inspecting six zones is not merely 4.5 hours of walking or hands-on work; preparation, depressurization, restoration, documentation and recovery also count. The student identifies inspections that can be robotic, tasks requiring two people and noncritical work that will be cancelled when an incident consumes half a day.

Operational table

Phenomena / sections:	7 — Navigation, communications and state knowledge ; 8 — Survival and human factors
Relationship to revisit:	couverture = stock / consommation
Expected decision:	measure → compare with margin → choose nominal, degraded or stop

Check before continuing

Explain without rereading: 7 — Navigation, communications and state knowledge ; 8 — Survival and human factors. State one measured quantity, one margin and one possible decision.

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9 — Mission-specific injected incident

On sol 4, a secondary electrical network is unavailable; the crew must choose between ISRU activation, external inspection and accelerated refuge commissioning. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

For AM-16.05, the answer must show which quantities in “The first thirty sols: move from landing to a stable base” are recomputed, which assumptions cease to be valid and which action remains reversible before consuming an irreversible reserve.

Failure of the secondary electrical network on sol 4 forces prioritization. Life-supporting loads and diagnostic capability are preserved first, followed by a decision about ISRU, external inspection and science. Restart conditions are stated, and repetitive energization without understanding the cause is prohibited so that one isolated failure does not become a common-cause event.

10 — Decision and justification

End with an explicit decision: continue, delay, reconfigure, abandon an activity or enter refuge mode. Cite the three quantities controlling that decision and the remaining margin. A conclusion without a numerical or operational criterion is an opinion, not an engineering decision. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

At sol 30 the base is assessed with measurable criteria: energy autonomy, water inventory, communications availability, number of open anomalies, refuge capability and recovery from an injected failure. The final report compares the achieved configuration with the original plan and explains deviations instead of hiding them inside a single availability average.

Operational table

Phenomena / sections:	9 — Mission-specific injected incident ; ; 10 — Decision and justification
Relationship to revisit:	couverture = stock / consommation
Expected decision:	measure → compare with margin → choose nominal, degraded or stop

Check before continuing

Explain without rereading: 9 — Mission-specific injected incident ; ; 10 — Decision and justification. State one measured quantity, one margin and one possible decision.

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11 — Required deliverables

12 — Assessment rubric

40%: calculation and unit consistency; 20%: interface treatment; 15%: margins and degraded mode; 15%: human factors and procedure; 10%: source quality and separation of data, assumptions and scenarios. For this mission, the criterion is applied explicitly to « The first thirty sols: move from landing to a stable base ».

13 — Reference sources

Topic-specific primary sources

NASA — Systems Engineering Handbook - <https://www.nasa.gov/reference/systems-engineering-handbook/>
NASA NTRS — Advanced Exploration Systems Life Support Systems Project Overview - <https://ntrs.nasa.gov/citations/20210015025>
NASA NTRS — Human Exploration of Mars: Preliminary Lists of Crew Tasks - <https://ntrs.nasa.gov/citations/20190001401>
NASA — NASA Spaceflight Human-System Standard Volume 2 - <https://www.nasa.gov/reference/nasa-std-3001v2/>

Operational table

Phenomena / sections:	11 — Required deliverables ; 12 — Assessment rubric ; 13 — Reference sources
Relationship to revisit:	couverture = stock / consommation
Expected decision:	measure → compare with margin → choose nominal, degraded or stop

Check before continuing

Explain without rereading: 11 — Required deliverables ; 12 — Assessment rubric ; 13 — Reference sources. State one measured quantity, one margin and one possible decision.