1 Descriva brevemente la sua esperienza professionale e formativa in relazione all'attività richiesta dal bando.

2 Si descrivano i principali elementi di un apparato di bordo SAR o ottico a scelta che ne determinano l'affidabilità nell'ambiente spaziale, e si individuino le tipiche attività di verifica.

3 Il candidato illustri le principali finalità del Documento di Visione Strategica (DVS) e del Piano Triennale delle Attività (PTA) attualmente vigenti e si motivi brevemente la ragione della loro contemporanea esistenza

If this is a government project the mission planner needs to evaluate whether the Department of Agriculture or U.S. Forest Service is going to support funding or attempt to sabotage the project. Will they see it as a boon to their fire fighting mission or a threat, because there will be less need for fire fighting equipment and personnel, which will jeopardize Congressional funding? What agency will be responsible for the project after it is launched? Will their staffing and funding be increased to cover additional responsibilities? What international agreements cover firefighting support? Will foreign nations have a right to the information from FireSat? Does the U.S. face any liability from the release of the information on fires? In other words, would there be liability if FireSat did not report a fire? Under the U.N. Principles on Remote Sensing the U.S. is obligated to provide data to all nations at cost. Will the data supplied be raw data or enhanced data? Who will supply the equipment to analyze the data? Will the FireSat mission as planned support all requests for information? What infrastructure will be necessary to support the U.S.'s treaty obligations? Who will pay for it?

From a mission perspective how many satellites will be necessary? What is the replacement strategy? Who are the launch providers going to be? Can these satellites be launched with other satellites (size and position questions) or do they require dedicated launches? Are there any satellites using these altitudes? What is the space debris situation? Are any special shields required to protect the satellite? Do the FireSat sensors pose any threat of interference to other satellites? Are the mission and function of the FireSat satellites in total conformity with U.S. international policy? Might not Brazil, for example, object to the monitoring of their forests, fearing that the U.S. was trying to make a case to hold them responsible for their failure to control burning in the forests?

These are examples of the kinds of questions that need to be answered. Inevitably the answers cause more questions. From the limited information we have about the FireSat Mission, I believe that from a legal and policy perspective the mission is doable. I am aware of the saying, "If you cannot stand the answer do not ask the question." However, it is a foolish mission planner that refuses to at least know of the risks.

21.1.8 Asteroids

There has been recent interest in asteroids (Space Development Corporation) as a potential mining opportunity. Private businessmen have proposed launching missions to asteroids to bring back rare and precious metals. There is also interest in the Moon and it is said to contain aluminum, calcium, iron, silicon, and small amounts of chromium, magnesium, manganese and titanium. It also has oxygen and sulfur. Some have proposed to do this regardless of the legal and policy issues. The question of ownership of asteroids and the right to sever valuable ore is not totally clear.

The Moon Treaty of 1979 addresses the subject of mining the Moon, asteroids and other celestial bodies. In general it provides for the establishment of an International Regime to authorize and control any mining activity at such time as the exploitation of natural resources becomes feasible. A critical element of the Moon Treaty is the principle of the Common Heritage of Mankind. Under this principle there is the commitment that all nations must share in the management and benefits from such activity. It is this provision for sharing of benefits without contribution of investment that has caused the U.S. and other space-faring nations to refrain from joining the treaty. Only Australia, Austria, Chile, Mexico, Morocco, The Netherlands, Pakistan, The Philippines and Uruguay have ratified the agreement.

Bando 30/2021 – Profilo UTC3

Il candidato a partire dalla tabella di seguito riportata (che sarà fornita all'interno del file excel denominato **cartel1**) provveda alle seguenti azioni:

classe	gennaio	febbraio	marzo	aprile	maggio	giugno	luglio	agosto	settembre	ottobre	novembre	dicembre
Prima	25	16	20	28	30	18	30	16	27	23	23	24
Seconda	30	11	2	5	3	6	30	31	28	17	22	23
Terza	24	24	110	30	21	15	24	31	28	22	91	19
Quarta	30	26	8	8	25	0	18	26	1	4	26	6
Quinta	18	12	21	15	29	19	30	21	27	40	72	39

1) Calcolare la media per riga e per colonna

2) Fare il grafico dei valori medi per classe

3) Salvare i file generati sul desktop del PC nominandoli con nome cognome

1 Descriva brevemente la sua esperienza professionale e formativa in relazione all'attività richiesta dal bando.

2 Si descriva sinteticamente la scala del Technology Readiness Level (TRL) per apparati spaziali di bordo, facendo anche esempi per payload ottici o SAR.

3 Si identifichino le figure chiave all'interno di un team di gestione e se ne dettagli il ruolo del Responsabile di Programma come da regolamento di organizzazione dell'Agenzia.

TABLE 19-7. Representative Methods for Fault Avoidance.

Technique	Most Suitable for	Limitations
Process Control	Current deficiencies exist	User must be able to influence process
Design Margins, etc.	Known failure risk	Adds weight and cost
Coding Techniques	Memory upset	Digital components only
Part Selection and Screening	Modest improvement required	Critical measurements must be known

and this is where major emphasis for fault avoidance through tighter process control should be placed.

A good starting point for investigating the feasibility and effectiveness of tighter process controls for fault avoidance is to investigate past failures in test and operation, and, particularly for new components or processes, difficulties that have been experienced during engineering evaluations. These constitute the "current deficiencies" listed in Table 19-7, and for each the underlying cause of failure must be identified. Where dispersions in material or process characteristics are implicated, tighter process control can be expected to make a significant contribution to fault avoidance.

Design Margins, Derating and Environmental Protection

Design margins and derating accomplish the same goal: prevention of component failure due to higher than expected external stresses or other deviations from the nominal conditions. The term *design margin* is mostly used in structure and thermal subsystems and means that a component is designed to carry more than the expected load. *Propellant margins* in propulsion systems are an equivalent concept. The term *derating* is primarily applied to electrical and electronic components and involves the specification of a component that carries a higher rating than is needed for the application.

The reliability improvement by these practices is most significant if a part is initially used near its design strength or electrical rating. As an example (from MIL-HDBK-217F), the predicted base failure rate for a fixed film resistor at 40° C and used at 0.9 of rated power is 0.0022×10^{-6}/hour. Selecting a higher rated resistor, for which the dissipated power constitutes only 0.3 of rated power reduces this to 0.0011×10^{-6}/hour. But further reductions are hard to achieve. A resistor for which the dissipated power is 0.1 of the rating still has a failure rate 0.0009×10^{-6}/hour. Derated parts not only cost more, but are frequently larger and heavier than the ones that they replace. Derating only reduces the failure probability with respect to the stress that is being derated. In the example of the fixed film resistor, derating reduces the probability of failure due to power surges but it does not offer any protection against failures due to lead breakage or corroded connections.

Environmental protection can take the form of shock mounting, cooling or heating provisions, and shielding against radiation effects, Where derating reduces the failure probability by increasing the strength of the components, environmental protection reduces the failure probability by reducing the stress levels. In many cases, environmental protection adds considerable weight, and this, rather than cost, limits the amount of protection that can be provided.

Bando 30/2021 – Profilo UTC3

Il candidato a partire dalla tabella di seguito riportata (che sarà fornita all'interno del file excel denominato **cartel2**) provveda alle seguenti azioni:

Direzioni	Unità	Area	2018	2019	2020
DIR A	U 1	A 1.1	500	0	500
DIR A	U 1	A 1.2	800	50	600
DIR A	U 1	A 1.1	250	100	350
DIR A	U 2	A 2.1	300	200	300
DIR A	U 2	A 2.2	500	700	500
DIR B	U 3	A 3.1	800	500	600
DIR B	U 3	A 3.2	250	700	350
DIR B	U 3	A 3.3	300	150	300
DIR C	U 4	A 4.1	500	300	500
DIR C	U 4	A 4.2	800	500	600
DIR C	U 5	A 5.1	250	700	350
DIR C	U 5	A 5.2	300	150	300
DIR C	U 6	A 6.1	1000	300	1000

1) Fare un istogramma dei dati per Direzione nel triennio.

2) Salvare il file generato sul desktop del PC nominandoli con nome cognome.

1 Descriva brevemente la sua esperienza professionale e formativa in relazione all'attività richiesta dal bando.

2 Si descrivano le principali differenze nello sviluppo di tecnologie per il segmento spaziale e per quello di terra.

3 Si descrivano brevemente i principali reati contro la Pubblica Amministrazione e di quelli identificati se ne scelga uno e lo si dettagli.

where R is the number of errors per bit day, a and b are device surface dimensions in μm, c is the device depth in μm, and Q_c is the critical charge in pC. These two equations have been shown to predict upset rates in the geosynchronous orbit for solar minimum conditions with reasonable accuracy. Scale factors for estimating error rates for other orbits and other calculational methods may be found in Petersen [1995].

Single-event upset rates in complex devices such as microprocessors, or single-event latchups or burnouts in any devices, cannot be reliably predicted. We must resort to predictions based on simulated accelerator test observations and flight performance of similar devices.

Galactic cosmic rays can also generate background noise in various satellite subsystems such as star sensors, infrared detectors, and components employing charge-coupled devices. In addition to increased noise signals, these rays create spurious events which can masquerade as real signals. The spurious signals can affect satellite subsystems depending on the genuine signals' frequency of occurrence, time duration, and repetition, as well as the sophistication of the sensor system. Galactic cosmic rays are a potential source of background noise which must be taken into account when designing a satellite system. It should also be noted that, while this section addresses effects of galactic cosmic rays, similar effects are caused by high energy protons and must be considered for orbits in the range of 1,000–10,000 km altitude.

8.2 Hardness and Survivability Requirements

Paul Nordin, ***The Boeing Company***
Malcolm K. Kong, ***TRW Systems & Information Technology Group***

Survivability is the ability of a space system to perform its intended function after being exposed to a stressing natural environment or one created by an enemy or hostile agent. *Hardness* is an attribute defining the environmental stress level which a space system can survive. As an example, a satellite or spacecraft which can withstand an X-ray fluence of 1.0 cal/cm^2 or absorption of 10^7 rads (Si) of total dose (a rad of absorbed dose is approximately 100 ergs/g) has a hardness of that amount. (*Fluence* is the time integral of flux. *Flux* is the flow of energy per unit time and per unit cross-sectional area.)

In the aerospace industry we now consider both natural and hostile environments in the definition of hardness and survivability. Well-developed technologies, evolved over the last 35 years, make it possible to design satellites to withstand natural and modest levels of hostile environments. Although technologies for hardening against hostile military threats and for natural survival of satellites overlap, they are distinct and are usually treated separately except in the areas of survivability to total dose due to the Van Allen belts, single-event effects (SEE) caused by galactic cosmic rays and high energy protons, and space/bulk charging due to naturally occurring space plasmas. The latter phenomena must be treated synergistically in the design of satellites.

A military space system or commercial satellite must be survivable if we will need its services in times of high stress, such as a nuclear war. To do this, we must understand what may cause the system to malfunction and then design it to protect against failures. Survivability requirements include identifying the environments and their intensities and, in most cases, designing the space system so it will continue to perform its intended function for a specified time after exposure.

Bando 30/2021 – Profilo UTC3

Il candidato a partire dalla tabella di seguito riportata (che sarà fornita all'interno del file excel denominato **cartel1**) provveda alle seguenti azioni:

classe	gennaio	febbraio	marzo	aprile	maggio	giugno	luglio	agosto	settembre	ottobre	novembre	dicembre
Prima	25	16	20	28	30	18	30	16	27	23	23	24
Seconda	30	11	2	5	3	6	30	31	28	17	22	23
Terza	24	24	110	30	21	15	24	31	28	22	91	19
Quarta	30	26	8	8	25	0	18	26	1	4	26	6
Quinta	18	12	21	15	29	19	30	21	27	40	72	39

1) Calcolare l'incidenza percentuale annuale per ciascuna classe e il valore medio complessivo per mese;

2) Fare un grafico rappresentativo dei risultati

3) Salvare i file xls e ppt e generati sul desktop del PC nominandoli nome_cognome

Bando 30/2021 - Profilo UTC3

1 Descriva brevemente la sua esperienza professionale e formativa in relazione all'attività richiesta dal bando.

2 Si descriva il ciclo di vita di un sistema spaziale anche facendo riferimento a standard internazionali quali ECSS.

3 Si descrivano le competenze e il ruolo del Comitato Tecnico Scientifico all'interno dell'Agenzia come indicato nello statuto dell'Ente.

Chapter 21

Limits on Mission Design

21.1 Law and Policy Considerations

William B. Wirin, *University of Colorado, Colorado Springs*

Why Worry About Law and Policy?

Engineers accustomed to precise answers often find that legal and political issues intrude on the space mission design process just when everything is going smoothly. However, I hope to shed some light on potential policy "show stoppers," and more importantly, provide some insight into legal thinking about space missions and valid, even critical, perils in the design process.

Policy results from balancing conflicting interests, so "valid" arguments may be rejected. Lawyers tend to give "answers" rather than an evaluation of political and legal risks. They unfairly believe that individuals from other disciplines will not understand and appreciate the balancing of interests. General James V. Hartinger, first Commander of Space Command, put it succinctly, "Lawyers are asked common sense questions so often that they begin to believe they have common sense." The mission planner should look to lawyers to evaluate policy and legal risks for various mission alternatives so they can be weighed along with technical factors.

Why worry about law and policy? The simple answer is that a perfect engineering solution is useless until it can be implemented. An example is the Apstar satellite. It was launched in July 1994 by the PRC without obtaining coordination from "owners" of nearby communications satellites as required by the International Telegraphic Union (ITU) regulations. Without the required consultations the satellite would not be permitted to transmit signals and therefore would be of little value. The result was a flurry of activity to conclude the negotiations quickly and this was accomplished a few months after launch. Had this been a U.S. launch it would have been postponed until the proper authorizations were accomplished, resulting in needless expense.

Bando 30/2021 – Profilo UTC3

Il candidato a partire dalla tabella di seguito riportata (che sarà fornita all'interno del file excel denominato **cartel1**) provveda alle seguenti azioni:

classe	gennaio	febbraio	marzo	aprile	maggio	giugno	luglio	agosto	settembre	ottobre	novembre	dicembre
Prima	25	16	20	28	30	18	30	16	27	23	23	24
Seconda	30	11	2	5	3	6	30	31	28	17	22	23
Terza	24	24	110	30	21	15	24	31	28	22	91	19
Quarta	30	26	8	8	25	0	18	26	1	4	26	6
Quinta	18	12	21	15	29	19	30	21	27	40	72	39

1) Calcolare le medie di ciascuna riga e di ciascuna colonna
2) Fare un grafico che rappresenti l'andamento dei totali nei mesi
3) Salvare i file generati sul desktop del PC nominandoli con nome cognome

1 Descriva brevemente la sua esperienza professionale e formativa in relazione all'attività richiesta dal bando.

2 Si descrivano le principali prospettive tecnologiche per futuri payload SAR oppure ottici di nuova generazione.

3 Il candidato nell'ambito del diritto penale descriva brevemente la differenza tra reato di concussione e reato di corruzione.

Chapter 19

Space Manufacturing and Reliability

19.1 Designing Space Systems for Manufacturability

Wade Molnau, ***Motorola Systems Solutions Group***
Jean Olivieri, ***Motorola Advanced Systems Division***
Chad Spalt, ***Motorola Satellite Communications Group***

Historically, satellite manufacturing, integration, and test has been a crafted and arduous process. Each spacecraft is essentially unique, and is manufactured and tested appropriately. Commercial satellites, while alleviating some of the major impedances to fast and efficient satellite manufacture, have fared only slightly better. The advent of commercial constellations of satellites forces us to seek and develop completely new strategies. We need to incorporate ideas and methods from other industries into satellite supply-chains to meet the cost and cycle-time requirements needed to make space systems compete effectively with their terrestrial counterparts.

This chapter describes a few of the vital changes that need to be addressed to manufacture and test multiple satellites efficiently. These methods and strategies apply to the whole satellite supply chain, and to piece-part, assembly, subsystem, and spacecraft levels. Chapter 12 detailed methods used to manufacture and test single satellites. This chapter augments Chap. 12 for multiple satellite systems.

Small satellite systems (< 10 spacecraft) may not fully benefit from the methods presented here, but some points will be applicable. Designing manufacturable satellites and associated production systems requires up-front investments in time, money, and capital. Each program needs to trade the benefits of these methods with anticipated investment costs. As the number of satellites grows, the benefits and the usefulness of these methods increases.

Bando 30/2021 – Profilo UTC3

Il candidato a partire dalla tabella di seguito riportata (che sarà fornita all'interno del file excel denominato **cartel2**) provveda alle seguenti azioni:

Direzioni	Unità	Area	2018	2019	2020
DIR A	U 1	A 1.1	500	0	500
DIR A	U 1	A 1.2	800	50	600
DIR A	U 1	A 1.1	250	100	350
DIR A	U 2	A 2.1	300	200	300
DIR A	U 2	A 2.2	500	700	500
DIR B	U 3	A 3.1	800	500	600
DIR B	U 3	A 3.2	250	700	350
DIR B	U 3	A 3.3	300	150	300
DIR C	U 4	A 4.1	500	300	500
DIR C	U 4	A 4.2	800	500	600
DIR C	U 5	A 5.1	250	700	350
DIR C	U 5	A 5.2	300	150	300
DIR C	U 6	A 6.1	1000	300	1000

1) Calcolare i totali di Unità nel triennio e rappresentarli in un grafico a torta. Calcolarne inoltre la media per anno.

2) Salvare il file generato sul desktop del PC nominandoli nome_cognome

Bando 30/2021 - Profilo UTC3

1 Descriva brevemente la sua esperienza professionale e formativa in relazione all'attività richiesta dal bando.

2 Si descrivano le tipiche fasi di un progetto spaziale e quali sono le modalità di verifica associate.

3 Il candidato illustri le principali differenze fra il Documento di Visione Strategica (DVS) e Piano Triennale delle Attività (PTA) attualmente vigenti e descriva brevemente i contenuti di uno dei due a scelta.

ing Management [Defense Systems Management College, 1990]. The *NASA Systems Engineering Handbook* [Shishko, 1995] provides an excellent and detailed account of the process used by NASA. Przemieniecki [1990a, b] provides a good introduction to mathematical methods associated with military programs and has an associated software package. Other software packages intended specifically to support mission evaluation include *Satellite Tool Kit (STK)* from Analytical Graphics (1998), the *Mission Utility/Systems Engineering module (MUSE)* from Microcosm (1998), and the Edge product family from Autometric (1998).

3.1 Step 7: Identification of Critical Requirements

Critical requirements are those which dominate the space mission's overall design and, therefore, most strongly affect performance and cost*. For a manned mission to Mars, the critical requirements will be clear: get to Mars all of the required mass to explore the planet and return, and maintain crew safety for a long mission in widely varying environments. For less ambitious space missions, we cannot establish the critical requirements so easily. Because we want to achieve the best performance at minimum cost, we need to identify these key requirements as early as possible so they can be a part of the trade process.

Table 3-1 lists the most common critical requirements, the areas they typically affect, and where they are discussed. There is no single mechanism to find the critical requirements for any particular mission. Like the system drivers discussed in Sec. 2.3, they may be a function of the mission concept selected. Consequently, once we establish the alternative mission concepts, we usually can determine the critical requirements by inspection. Often, concept exploration itself exposes the requirements which dominate the system's design, performance, and cost. One approach to identification of critical requirements is as follows:

1. *Look at the principal performance requirements.* In most cases, the principal performance requirement will be one of the key critical requirements. Thus, for FireSat, the requirements on how well it must detect and monitor forest fires would normally be principal drivers of the system design.
2. *Examine Table 3-1.* The next step is to look at the requirements list in Table 3-1 and determine which of these entries drive the system design, performance, or cost.
3. *Look at top-level requirements.* Examine each of the top-level requirements established when we defined the mission objectives (Sec. 1.3) and determine how we will meet them. For each, ask whether or not meeting that requirement fundamentally limits the system's design, cost, or performance.
4. *Look for hidden requirements.* In some cases, hidden requirements such as the need to use particular technologies or systems may dominate the mission design, and cost.

---

* Critical requirements should be distinguished from *system drivers* (as discussed in Sec. 2.3), which are the defining mission parameters most strongly affecting performance, cost, and risk. The goal of mission engineering is to adjust both the critical requirements (e.g., coverage and resolution) and the system drivers (e.g., altitude and aperture) to satisfy the mission objectives at minimum cost and risk.

Bando 30/2021 – Profilo UTC3

Il candidato a partire dalla tabella di seguito riportata (che sarà fornita all'interno del file excel denominato **cartel1**) provveda alle seguenti azioni:

classe	gennaio	febbraio	marzo	aprile	maggio	giugno	luglio	agosto	settembre	ottobre	novembre	dicembre
Prima	25	16	20	28	30	18	30	16	27	23	23	24
Seconda	30	11	2	5	3	6	30	31	28	17	22	23
Terza	24	24	110	30	21	15	24	31	28	22	91	19
Quarta	30	26	8	8	25	0	18	26	1	4	26	6
Quinta	18	12	21	15	29	19	30	21	27	40	72	39

1) Calcolare l'incidenza annuale per ciascuna classe;

2) Fare un grafico a torta rappresentativo dei risultati

3) Salvare i file generati sul desktop del PC nominandoli con nome cognome

1 Descriva brevemente la sua esperienza professionale e formativa in relazione all'attività richiesta dal bando.

2 Si descrivano i pro e i contro associati ad attività di validazione in orbita (IOD) per apparati di nuovo sviluppo SAR o ottici.

3 Si elenchino brevemete quali sono gli organi dell'Agenzia e si descrivano le competenze e le funzioni del Consiglio Tecnico Scientifico.

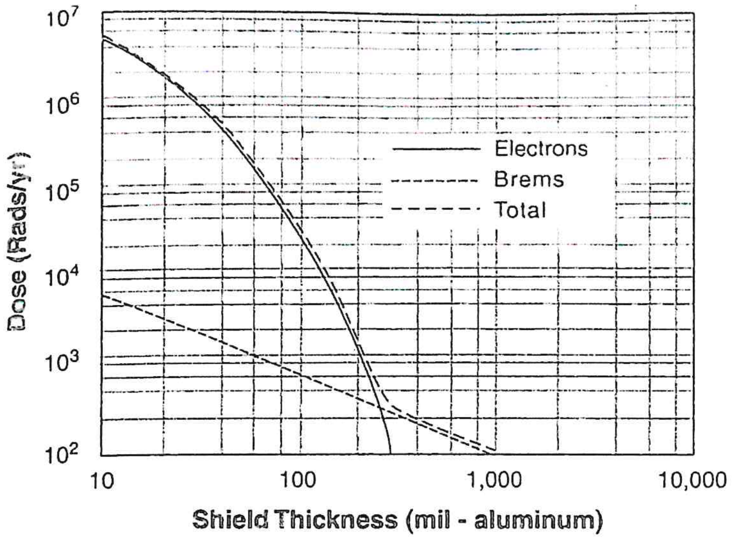

Fig. 8-10. Radiation Dose Rate in Geosynchronous Equatorial Orbit for Various Shield Thicknesses.

*Solar Particle Events**

Solar particle events (SPEs) occur in association with solar flares. SPEs are rapid increases in the flux of energetic particles (~ 1 MeV to above 1 GeV) lasting from several hours to several days. On the average, only a few SPEs occur per year; however, they have important consequences for man-made systems and for man in space. For example, they degrade solar array elements, increase background noise in many types of electro-optical sensors, and cause illnesses in astronauts.

Figure 8-11 shows the typical evolution over time of a solar particle event observed near Earth. The profile depends on the time evolution of the originating solar flare, how long the energetic particles take to diffuse within the solar corona and how the particles propagate within the interplanetary medium. Protons of relativistic energies arrive at Earth within minutes after the flare's occurrence. Lower energy (~10's of MeV) protons are slowed by diffusion within the solar corona and by interactions with the interplanetary medium. After a solar particle event occurs, proton fluxes decay to background noise values over several days. The practical importance of an individual event depends on its maximum intensity, its duration, and the relative abundance of the highest-energy components and heavy nuclei.

The frequency of proton events peaks within a year or two of sunspot maximum and diminishes greatly during the few years surrounding sunspot minimum. Nevertheless, intense events can occur virtually any time within the 11-year sunspot cycle except at sunspot minimum. Table 8-4 shows when the most and fewest sunspots will occur for solar cycles 21–25.

The intensities of typical solar proton events closely follow a log-normal distribution [Jursa, 1985; King, 1974; Feynman et al., 1988]; thus, a few individual events can dominate the total proton fluence observed over a complete solar cycle. Table 8-5 shows the parameters of this distribution. For example, using the values in Table 8-5, a typical solar proton event has a fluence above 10 MeV of $10^{8.27}$ cm^{-2}, whereas an extreme (3σ) event would contribute $10^{(8.27 + 3 \times 0.59)}$ cm^{-2} = 1.1×10^{10} cm^{-2}.

* Contributed by D. J. Gorney, *The Aerospace Corporation.*

Bando 30/2021 – Profilo UTC3

Il candidato a partire dalla tabella di seguito riportata (che sarà fornita all'interno del file excel denominato **cartel2**) provveda alle seguenti azioni:

Direzioni	Unità	Area	2018	2019	2020
DIR A	U 1	A 1.1	500	0	500
DIR A	U 1	A 1.2	800	50	600
DIR A	U 1	A 1.1	250	100	350
DIR A	U 2	A 2.1	300	200	300
DIR A	U 2	A 2.2	500	700	500
DIR B	U 3	A 3.1	800	500	600
DIR B	U 3	A 3.2	250	700	350
DIR B	U 3	A 3.3	300	150	300
DIR C	U 4	A 4.1	500	300	500
DIR C	U 4	A 4.2	800	500	600
DIR C	U 5	A 5.1	250	700	350
DIR C	U 5	A 5.2	300	150	300
DIR C	U 6	A 6.1	1000	300	1000

1) Calcolare il totale nel triennio di ciascuna Unità e ordinarli in modo decrescente

2) Salvare il file generato sul desktop del PC nominandoli con nome cognome