Question1:

1. It is possible. A 50-year flood event is expected to happen every 50 years, which doesn't mean the chance of this kind of event happened in two consecutive years is zero.
2. Each year, the probability of a 100-year flood event happen is 1/100, so:

$$P = 1 - (1 - 1/100)^{20} = 0.18$$

3. a.

Table 1. the annual maximum series

Years	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual Maximum	152.3	132.6	195.6	166.8	179.6	98.9	145.7	113.7	134.5	101.4	153.9
Years	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
Annual Maximum	136.1	124.9	183.7	147.8	141	136.3	143	148.7	180.4	168.2	

b. Please see the table 2.

As we know:

Gringorten formula:

$$Return\ Periods\ (T) = \frac{(N + 0.12)}{(m - 0.44)}$$

Where N is the total number of years or record, m is the rank or the magnitude.

c. Please see the table 2.

Table 2. Analysis of the annual maximum flood.

Years	Annual Maximum	Rank	Recurring period	Probability of occurrence
1982	195.6	1	37.71429	0.026515
1993	183.7	2	13.53846	0.073864
1999	180.4	3	8.25	0.121212
1984	179.6	4	5.932584	0.168561
2000	168.2	5	4.631579	0.215909
1983	166.8	6	3.798561	0.263258
1990	153.9	7	3.219512	0.310606
1980	152.3	8	2.793651	0.357955

1998	148.7	9	2.46729	0.405303
1994	147.8	10	2.209205	0.452652
1986	145.7	11	2	0.5
1997	143	12	1.82699	0.547348
1995	141	13	1.681529	0.594697
1996	136.3	14	1.557522	0.642045
1991	136.1	15	1.450549	0.689394
1988	134.5	16	1.357326	0.736742
1981	132.6	17	1.275362	0.784091
1992	124.9	18	1.202733	0.831439
1987	113.7	19	1.137931	0.878788
1989	101.4	20	1.079755	0.926136
1985	98.9	21	1.027237	0.973485

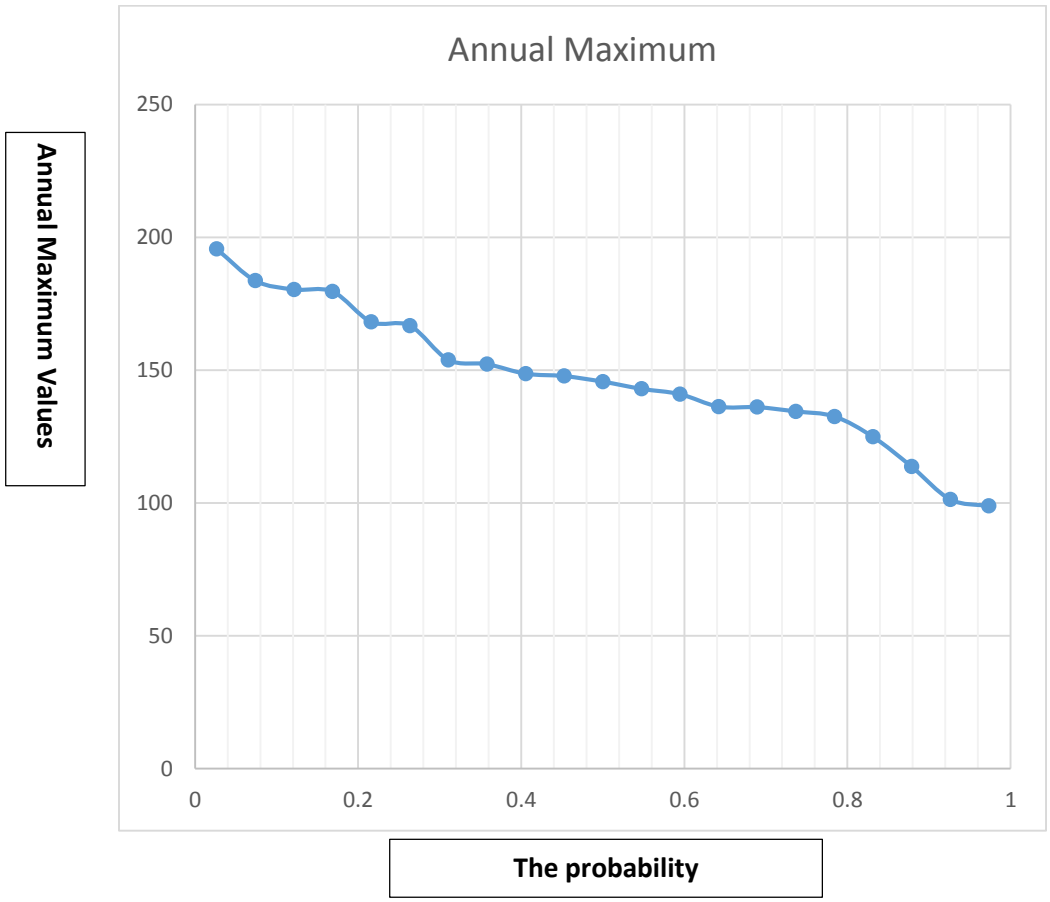

Figure 1. Annual Maximum to probability

From the graph 1 and the table 1, the rainfall magnitude of 50% probability of exceedance about 145.7mm.

Question 2:

2.1.

Pros	Cons
Wind energy is a green energy source and does not cause pollution.	Wind is a fluctuating (intermittent) source of energy and is not suited to meet the base load energy demand unless some form of energy storage is utilized
Since originated from the sun, Wind power is renewable and there is no way we can run out of it.	Wind turbines can be a threat to wildlife, such as birds.
The operational costs associated with wind power are lo	Noise is regularly reported as a problem by neighboring homes

Wind energy is of course, viable. It is cheap to harvest, compared to solar energy. It is safe to operate, compared to the nuclear energy. It has been used by human being for hundreds years ago. In Netherland, there are still windmills which were built many years before. Today, with new materials, we can utilize the wind energy to generate power easily.

2.2.

a).

As we know, at 1atm, 25Celsius, $p = 1.1839\text{kg/m3}$

$$\lambda = \frac{blade\ tip\ speed}{wind\ speed} = \frac{2 \times \pi \times f \times R}{v} = \frac{2 \times \pi \times 12rpm \times 60m}{15m/s} = 5.027$$

From the $C_p - \lambda\ \ graph$, we can find $C_p = 0.275$

The power of the wind turbine is P_t

$$P_t = \frac{1}{2}mv^2C_p = \frac{1}{2} \times p \times V \times v^2 \times C_p = \frac{1}{2} \times p \times S \times v \times v^2 \times C_p$$
$$= \frac{1}{2} \times 1.1839\text{kg/m3} \times \pi \times (60\text{m})^2 \times \left(\frac{15m}{s}\right)^3 \times 0.275 = 6.212\ MW$$

b).

So, the wind power density $= \frac{P_{wind}}{S} = \frac{1}{2} \times p \times v \times v^2 = \frac{1}{2} \times 1.1839\text{kg/m3} \times (15m/s)^3 = 2.0 \times 10^{-3}\text{MW}/M^2$

c).

Assuming the total energy of the wind turbine in 5 years is $W_{5\ years}$

$$W_{5\ years} = P_t \times t = 6.212\ MW \times (5 \times 365 \times 24 \times 60 \times 60)s = 9.7951 \times 10^8\ \ MJ$$

Question3.

3.1.

PV is the abbreviation of photovoltaic technology, which can convert solar energy directly into electricity. Where, the sunlight are usually non-concentrated. CSP technologies refers concentrated solar power or concentrated solar thermal. Its characteristics of generating solar power by using mirrors or lenses to concentrate a large area of sunlight. CSP generate electricity by using heat engine such as steam turbine. The output power scale of PV can be few watts to several hundred MW, while the output power of CSP is always more than hundreds MW.

3.2.

Assuming we need x piece of solar panels to meet our goal.

Then,

$$60\% \times 11000kWh = 4.5hours \times x \times 365 \times \frac{1kW}{5} \times 0.7$$

$$x = 28.7 \approx 29$$

So, we need at least 29 piece of solar panel to meet our need.

Question 4.

4.1.

Both nuclear fusion and nuclear fission are nuclear reaction. Nuclear fusion refers that two or more atomic nuclei collide at a very high speed and join to form a new type of atomic nucleus. Therefore, nuclear fusion always happened to light nucleus such as hydrogen nucleus. Nuclear fission is the reverse process of fusion, where heavy nucleus breaks apart into two lighter ones. In both process, large amount of energy will release due to the loss of mass. However, nuclear fusion have higher energy density.

4.2.

a).

The alpha decay of Curium.

$$^{245}_{96}Cm \rightarrow ^{241}_{94}Pu + ^{4}_{2}He$$

b).

$$^{139}_{51}Sb \rightarrow {}^{0}_{-1}e + {}^{139}_{52}Te$$

c).

$$A = A_0 0.5^{t/T}$$

$$5ppm = 20ppm \times 0.5^{\frac{t}{28.8years}}$$

$$t = 57.6years$$