



His Majesty had initiated the Royal Rainmaking operation and monitored the result of the experiments from daily reports. He also studied from scientific documents, closely observed weather conditions; no matter if an experiment was on-going or not. As a result of his devotion, he could progressively develop a process of cloud seeding. In 1973, His Majesty delivered the principle of cloud seeding to the officers and this principle has continuously been used until 1999. The warm and cold cloud seeding consists of 6 steps as follows:

#### Warm Cloud Seeding

##### **Step I: Triggering**

This step begins when the sky in the target area is clear or only a few cumulus clouds have formed in the morning and the average relative humidity is at least 60 percent. Powder of Sodium Chloride, hereafter (NaCl), is dispersed from aircraft in the upwind side of the target area at the altitude of 7,000-8,000 ft. In order to activate cloud formation, each particle of Sodium Chloride acts as cloud condensation nuclei to absorb moisture and then change vapor into liquid or cloud droplets. The clouds can become with the top reaching the altitude of 10,000 ft.

##### **Step II: Fattening**

This step is to make the triggered clouds in the previous step and the natural clouds grow bigger. It starts when the cloud tops of the cumulus clouds formed in Step I reach the altitude of 10,000 ft. and an aircraft disperses powder of calcium chloride ( $\text{CaCl}_2$ ) into the clouds at the altitude of 8,000 ft. The heat from the chemical reaction of  $\text{CaCl}_2$  and moisture will expedite or enhance the updraft of air mass in the cloud. Therefore, the cloud growth increases continuously and the cloud top is higher than in the previous step. Its top can reach the altitude of 15,000 ft. where it becomes 'warm cloud' (the temperature in the cloud top is higher than  $0^\circ\text{C}$ ). If the updraft is enough, the cloud top can develop until it reaches the altitude of 20,000 ft. where it becomes cold cloud (the temperature in the cloud top is below  $0^\circ\text{C}$ ).

### **Step III: Attacking (Sandwich Technique)**

This is the case for warm cloud seeding which starts when the cumulus clouds formed in Step II move along the wind approaching the target area and the cloud tops reach the altitude of 10,000 ft. or higher. One aircraft disperses NaCl at the top or the shoulder of the clouds (an altitude of 9,000 ft.) on the upwind side. At the same time, the other aircraft applies urea at the altitude of 1,000 ft. above the base clouds. This results in two aircrafts flying simultaneously in parallel, making an angle of 45 degrees to the horizontal line. This flying technique is called 'sandwich'. After seeding, raindrops in cloud become densely bigger and move lower to the cloud base. The cloud becomes mature and rain starts to drop but not so much.

### **Step IV: Enhancing**

This step is to maintain Step III and enhance rainfall onto the ground. After operating step III, there may not be much rain because the atmosphere below the cloud base is drier and the temperature is higher than those in the cloud. Thus, the raindrops that falling through the cloud base rapidly evaporate. This step is done by dispersing dry ice flakes (-78°C) at the altitude of 1,000 ft. below the cloud base to lower air mass's temperature and increase relative humidity. This action will help reducing evaporation of raindrops. The rainfall rate gradually increases and a greater number of super-large raindrops reach the ground. This causes heavy rain which provides more amount of rainfall than that of natural rain.

### **Cold Cloud Seeding**

#### **Step V: Attacking Cold Cloud by Silver Iodide (AgI) Seeding**

This step is operated when the cloud top formed in Step II reaches the altitude of 20,000 ft. This process is done by ejecting flares of AgI into the cloud top at the altitude of 21,500 ft. After operation, the amount of ice will be formed especially at the cloud top. Freezing of droplets enhances the release of latent heat, increases cloud buoyancy and updraft, and induces moister air into the cloud base. The ice will grow much bigger before melting into be raindrops.

#### **Step VI: Attacking by Super Sandwich Technique**

This step is used when the cloud top in Step II reaches over the altitude of 20,000 ft. and the cloud condition is the same as that in step V. Warm and cold cloud attacking techniques are used at the same time with at least 3 aircrafts. The cold cloud seeding aircraft ejects flares of AgI into the cloud top (at the altitude of 21,500 ft.) while the other two aircrafts use sandwich techniques for warm cloud seeding, one dispersing NaCl at the mid-cloud level (about 10,000 ft.), and the other one dispersing Urea at the cloud base level. The warm cloud seeding aircraft may

disperse Dry Ice of Step IV in order to enhance rainfall. After seeding by the Super Sandwich Attacking Technique, the treated clouds start to produce heavy rain in large amounts for a prolonged period of time.