

EXECUTIVE SUMMARY

1. In an underground mine the roof i.e. the overlying rocks are to be properly supported to protect the workers & the machines at the coal face. For this purpose Self-Advancing Roof Supports (SARS) are used. They have the following salient components :
 - 2 to 6 hydraulic props (legs) fixed to a common base plate.
 - A heavy roof canopy (plate) mounted over the legs for setting against the roof.
 - A double acting horizontal hydraulic ram linked to the face conveyor for shifting the face conveyor and for pulling the support towards the face.
 - A rear guard shield for preventing the flow of debris into the face.
 - A power pack to provide the high pressure fluids through hoses as the power medium for moving the support.

2. The main application of Self-Advancing Roof Supports (SARS) is in the longwall system of mining. They perform the additional functions :
 - Protection of workers and the machines at coal faces.
 - Shift the coal face equipment with the help of hydraulic rams.
 - Provide immediate continuous support to the exposed roof.
 - Provide high rate of face advance in conjunction with coal cutting machines like shearer/plough.

3. There are two companies namely, Mining & Allied Machinery Corporation, Durgapur and Jessops and Co. Ltd., Calcutta, both in the public sector, which are engaged in the manufacture of SARS. In addition, two more units i.e. Bharat Earth Movers Ltd., and Andhra Pradesh Heavy Machinery Ltd. have come up recently.

4. All the 4 units are manufacturing the items with foreign collaboration. The details are :

<i>Indian Company</i>	<i>Foreign Collaborator/ Country</i>	<i>Year of Collaboration Agreement</i>
1. MAMC	Dowty/UK	1978
2. JESSOPS	Gullick Dobson/UK	1981
3. BEML	Mitsui Mikii/Japan	1987
4. APHMEL	Licensintorg/USSR	1987/88

5. The estimated sales during 1991-92 is as follows :

<i>Manufacturer</i>	<i>1991-92 (Support Nos)</i>
MAMC	400
JESSOPS	400
BEML	200
APHMEL	200
TOTAL	1200

6. The current demand forecast of SARS is of the order of 300-400 units per annum which may gradually build upto the level of 1000-1200units by 1999-2000.

7. The following are some of the leading manufacturers of SARS in the world :

- Gullick Dobson Ltd., UK
- Mitsui Mikii Machinery Co. Ltd., Japan
- Dowty Mining Equipment, UK
- Marrel Mines, France
- Hemscheidt, (West) Germany
- Westfalia Lunen (West) Germany

8. The principal manufacturers in West Europe have so far supplied around 150,000 units to mining industries. It is estimated that countries like USSR, China and Poland have also supplied a similar number mainly to their own mining industries.
9. The year 1977-78 saw a number of longwall faces coming into operation in India. The objective was to gain experience with different types of equipments and to get over the apprehension of the capability of Indian coal mining rocks for such operations. The above experiment had good success and by the end of 7th Plan, Coal India was operating 13 powered support longwall faces. In addition, Singhereni Coal Company was operating three powered longwall faces. In the final year of 8th Plan, CIL and SCCL have a plan to produce 10.85 and 6.42 million tonne of coal by 29 and 14 numbers of powered support faces, respectively.
10. Indigenisation efforts for the manufacture of Self Advancing Roof Supports gradually started within 4-5 years of its introduction in Indian mines in 1978. The necessity was felt, as after nationalisation of Coal India Ltd. which projected a massive mechanisation programme for its coal mines, it was not possible to run successfully, both technically and financially, completely imported longwall machineries, due to the following reasons :
 - i) High capital expenditure for import.
 - ii) Lack of suitable spares and long gestation period for import.

Heavy production losses were reported due to delay in repairing/major breakdowns. Therefore, desirability to produce the equipment locally was strongly felt. Serious efforts were initiated in this direction in the beginning of 1980s.

In the initial stage, manufacture of chocks with a yield load in the range of 200-300T was started. Gradually, after 2 to 3 years, manufacture of higher capacity chock shields (yield load above 300 T) was started. However the indigenisation effort has so far been limited to only structural parts. The hydraulics, controls and other units continue to be substantially imported.

11. The two main manufacturers of the equipment, i.e., MAMC and Jessop do not have sufficient R&D capabilities to undertake developmental work. The expenditure of MAMC on R&D during the last two

years has been as under :—

<i>Year</i>	<i>Expenditure (Rs. in crores)</i>
1987-88	0.02
1988-89	0.03

The expenditure of the other unit, i.e, Jessop & Co. during the last two years has been as under :—

<i>Year</i>	<i>Expenditure (Rs.in crores)</i>
1987-88	0.12
1988-89	0.11

In their R&D set up four full time persons are involved including two engineers. Most of the development work is done by the design section employing nearly 150 engineers. They are in the process of developing computer programmes for carrying out design and stress analysis of roof support components.

BEML which is taking up the production of this item, has good R&D facilities. They have a separate R&D centre in KGF which is exclusively devoted to undertake applied research, product development and testing in respect of various products manufactured by them. The Company has invested around Rs. 30 crores in their R&D set up. Total manpower strength at KGF R&D facilities is around 250 persons, out of which 175 are engineers. The Company is also planning to exclusively depute 16 persons for the R&D of SARS. Their R&D expenditure during the last 2 years has been as under :

1987-88	Rs. 7.72 crores
1988-89	Rs. 11.83 crores

12. The total projected production of coal from longwall faces and no. of faces in India as projected by Coal India are as follows :

	<i>1990-91</i>	<i>1994-95</i>	<i>1999-2000</i>
Total production from longwall faces (in million tonne)	5.8	17.27	24.65
No. of faces	20	43	75

Coal India has projected the following production from its underground coal mines :

	<i>1990-91</i>	<i>1994-95</i>	<i>1999-2000</i>
Total production (in million tonne)	69.97	88.97	100.05
Production from longwall faces (in million tonne)	3.79	10.85	15.39
No. of faces	15	29	52

The SCCL has projected the following figures from its mines :

	<i>1990-91</i>	<i>1994-95</i>	<i>1999-2000</i>
Total production (in million tonne)	—	33.59	37.785
Total Production from longwall faces (in million tonne)	2.01	6.42	9.26
No. of faces	5	14	23

As can be seen from the above, from a current level of around 20 faces it is projected to go up to 75 faces by 1999-2000 i.e. an addition of about 55 new longwall faces in the next decade. Alongwith the requirement of new sets for these additional faces, there will be need of replacement of the existing sets which have completed their service life. Thus in next ten years the demand is likely to be of the order of 75 sets i.e. about 7500 self-advancing roof supports.

13. Technological development in the longwall roof supports and associated control equipment has continued at a rapid rate since the first generation supports were introduced in the early 1950's. Emphasis has been placed on developing equipment which provides more effective roof control and therefore, improved safety for men, in addition to increased productivity. These objectives have been instrumental in progressing the design from the early articulated structures with their simple 'tap' control hydraulics, through 1970's second generation rigid

base chock supports and multi-function rotary and lever control system, to the current generation of electro-hydraulically controlled shield supports.

14. Lately, use of SARS has been made in non-coal mining situation also such as phosphates, rock salt, potash mining and others.
15. Development of ancillary industries is beneficial to both the suppliers and users. But stress on growth of such ancillaries for the main equipment as well as for spares has not been impressive with the result that even to-day a substantial requirement of spares (by value) is imported from the parent suppliers. This results in serious hold ups in production and sometimes spares are to be air freighted to meet emergent situation. Development of ancillary industry is expected to mitigate the problem to a certain extent.
16. The pace of indigenisation of components by the two manufacturers is rather slow. It is estimated that only about 20-30% of the components of the SARS are indigenously manufactured and the rest are imported. The indigenously manufactured components are mostly the structural parts.
17. Manufacture of Self Advancing Roof Supports requires technological inputs. All the 4 manufacturers, two of which have been in line for quite sometime, whereas the other two being new entrants, had the benefit of foreign collaborations. The import content of the two manufacturers is still high. It cannot, therefore be said that technology absorption by these two companies has been of a significant value. SARS are to be tailor made to suit the specific conditions of a mine and designs and drawings and other technological inputs received from the collaborators have to be suitably modified to suit the local conditions.
18. Adequate attention needs to be paid to the total system of quality control i.e. manpower, procedure and testing equipment. Assistance of foreign collaborators would be useful.
19. After Sales Service needs improvement in terms of experienced & trained Service Engineers provided with suitable tools and tackles backed by sufficient spare parts.
20. Unlike equipment in other industries, mining equipment are generally tailor made to each application. Only when a large number of

SARS are involved, possibility of standardisation in terms of size range/capacity can be attempted.

21. **Recommendations**

- (i) In view of the growing demand of longwall faces in the country and a wide technological gap existing in the items manufactured indigenously and the state-of-the-art, the industry needs to be established on sound footing with sufficient indigenous content.
- (ii) Manufacturers should endeavour to cut down manufacturing costs to level comparable to international prices.
- (iii) Currently, each manufacturer is trying to make all components, of longwall package. Even in case of SARS, they are envisaging separate manufacturing facilities for hydraulic components. Considering the overall requirements and the economics it may be worth-while for public sector units to pool their resources for centralised manufacturing facilities for hydraulic components. It may also be considered that each manufacturer specialises and concentrates in the development/specialisation in one area in the manufacture of SARS. For this purpose consensus among the manufacturers regarding development and specialisation is very desirable.
- (iv) Similarly, for raw materials they may initiate a scheme for central storage of imported raw materials to cut down time delays.
- (v) Proper planning of manufacturing processes, precise scheduling of work is required to avoid delay in delivery schedule. The design and planning departments of manufacturers should incorporate necessary changes required in their planning procedures.
- (vi) Research and Development needs to be strengthened by proper expertise and funds and function under the direct supervision of the top management so that the product is continuously updated.
- (vii) Suitable ancillary sector catering to the requirement of SARS manufacturers, needs to be developed.

- (viii) Centralised testing facilities at one/two places and standardisation of testing procedures is desirable to improve the manufacturing standards of SARS. The centralised testing facility may be funded by concerned organisations. These could be under some appropriate agencies such as CMPDI, CMRS or DGMS.
- (ix) It is important for the user to plan properly their requirement and place the orders with delivery in a staggered fashion so that the manufacturers can plan in advance regarding procurement of raw materials, bought out components, arrange necessary fund and take advance action in relevant areas. This may also help in reducing delivery schedules. This action together with standardisation of product would solve many problems.
- (x) Considering the large production of coal required by 2000 AD from underground mines, the Indian manufacturing sector should be geared up to meet the future requirements of SARS.