HIGH ANGLE CONVEYORS - HAC'S FROM MINE TO PREP PLANT AND BEYOND

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Abstract. High Angle Conveyors - HAC®s, are proven versatile systems for elevating or lowering materials continuously at steep angles to 90°. Widely varying industries have exploited the benefits of HAC®s. Materials handled include coal, refuse, coarse copper ore (-250 mm), hot clinker, municipal sludge, wood chips, gypsum, slag, excavated earth, various grains and RDF (refuse derived fuel - garbage). Throughput rates vary from 0.27 to 4,000 t/h. The conveying profiles vary widely and elevating heights range from 3.66 m to 175 m.

While noting a wide variety of applications, this article focuses on the suitability of HACs for the various elevating duties from underground and open pit coal mines, to screening, to prep plant, to coal loadout and refuse disposal. Various operating HACs at eastern and western U.S. mine facilities are cited and described.

1. INTRODUCTION

The Continental Conveyor HAC represents logical evolution and optimisation of the sandwich belt concept. The sandwich belt approach employs two ordinary rubber belts which sandwich the conveyed material. Additional force on the belt provides hugging pressure to the conveyed material in order to develop sufficient friction at the material-to-belt and material-to-material interface to prevent sliding back at the design conveying angle.

HACs can take on various forms (Figures 1-10) and offer many advantages over other systems, including:

Simplicity of Approach
The use of all conventional conveyor hardware. Operating experience thus far has revealed that HACs have very high availability and low maintenance costs.

Virtually Unlimited in Capacity
The use of conventional conveyor components permits high conveying speeds. Available belts and hardware up to 3,000 mm (120 inch) wide make capacities greater than 15,000 t/h possible.

High Lifts and High Conveying Angles
Lifts beyond 300 m (1000') are possible with standard fabric belts, and much higher single-run lifts are possible with steel cord or aramid fibre belts. High angles of up to 900 are possible.

Flexibility in Planning and in Operation
The Continental Conveyor sandwich belt lends itself to multi-module conveying systems using self-contained units as well as to single-run systems using externally anchored, high angle conveyors. In either case, the conveyor unit may be shortened or lengthened or the conveying angle may be altered according to the requirements of a new location.

Belts are Easily Cleaned and Quickly Repaired
Smooth surface belts allow continuous cleaning by belt scrapers or plows. This is

especially important in handling wet and sticky material. Smooth surface belts present no obstruction to quick repair of a damaged belt by hot or cold vulcanising.

Spillage-Free Operation

During operation, the material is sealed between the carrying and cover belts. Well-centred loading and ample belt edge distance result in no spillage along the conveyor length.

2. HAC® INSTALLATIONS - GENERAL

HACs are now in wide use throughout the world. Thirty-two (32) HAC units are currently in operation while nine (9) additional HAC®s are in various stages of engineering and manufacturing, scheduled for operation in 1993, and 1994. Table 1 summarises technical features of HACs to date.

It is worth noting that twenty-one (21) HACs elevate the conveyed materials at 90°.

3. HAC®s FROM MINE TO PREP PLANT AND BEYOND

Having noted the proven versatility of the HAC system, we now consider applications from underground coal mining to crushing and screening, to prep plant and beyond, to clean coal loadout and to refuse disposal. Since 1983, HAC installations have filled all of the important conveying and elevating functions of coal mining and preparation.

3.1 HAC® Haulage From Underground

The function of elevating coal from underground along a vertical shaft, is realised in HAC Unit 30. This is depicted in Figure 1 with technical data in Table 1. This fulfills the greatest potential, realising the greatest savings in the entire mine through prep plant sequence. Located in midwestern USA, the 1524mm wide HAC elevates the entire coal mine production at 1361 t/h, 104 m vertically to the surface discharging onto the plant feed conveyor. This most important system is but a harbinger of wider use of yet larger HAC systems from underground.

The wide use of longwall systems in the 1980s has required upgrade or replacement of existing conveyor lines to keep up with production. In deep coalmines this has resulted in choking at the main haulage shaft where existing skip hoists cannot meet the increased production requirements. This is creating great opportunities for high angle conveyors in the 1990s. Such systems will see lifts exceeding 300 m and conveying rates beyond 4000 t/h.

Another case of raw coal haulage from an underground coal mine is realised by the HAC unit of Figure 2 (Table 1 - Unit 11). This system elevates raw coal from the mine mouth of a western U.S.A. underground coal mine at 1089 t/h. It elevates raw coal from the slope conveyor to another upper conveyor that takes coal to stackout through a stacking tube.

3.2 Crushing and Screening

The two High Angle Conveyors, Units 26 and 27, depicted in Figure 3, with technical data in Table 1, are part of a coal crushing and screening system. The 1524mm wide HAC receives primary crushed coal, to 203 in size, from underground and elevates it to a screening tower. All 51 mm minus material passes through the screens and is conveyed to a load out silo while the 51 mm to 203 mm size passes over the screens and is loaded

onto the 1219 mm wide HAC which elevates it to a rotary breaker. At the breaker, rock is separated from the coal and discarded. The remaining coal is sent to silo for train loading.

3.3 Prep Plant Feed

Used in another critical location of the mine to prep plant route, the HAC unit of Figure 4 (Table 1 - Unit 8) elevates run-of-mine coal from a rock removal rotary breaker at 1089 t/h, providing a continuous feed to the prep plant.

3.4 Clean Coal to Loadout

Five (5) units, Figures 5 through 9 (Table 1 - Units 2, 4, 9, 19 and 29) convey clean coal to train loadout. The HAC unit of Figure 9 serves an intermediate function in elevating more than 50% of the mine's output from a slot storage barn to a sampling station and feeds a conveyor to the silos.

The vertical HAC of Figure 7 (Table 1 - Unit 9) elevates clean coal 76.2 (250') to discharge over the tallest train loading silo east of the Mississippi River in the U.S.A. The cost savings are significant compared to the traditional conventional conveyor elevating system.

This HAC arrangement will undoubtedly set the standard for the future in elevating to storage, blending and loadout silos.

The HAC unit of Figure 8 (Table 1 - Unit 19) presents an especially suitable method for collecting clean coal from under a stockpile and delivering it vertically to a cross conveyor to train loadout. This solution is ideal in the cramped storage space and provides the collecting and elevating functions without material transfer point.

3.5 Refuse Disposal

A second product of the prep plant, mine refuse, must be hauled to a waste dump. In Virginia and West Virginia, often such haulage must scale steep mountains for disposal in a permitted valley area.

The unit of Figure 10 (Table 1 - Unit 12) located in Virginia, USA, serves such a function. This HAC unit is of major proportions. Though modest in tonnage rate, at 454 t/h, the 914 mm wide belts elevate coal prep refuse, 175 m lift, 454 m, along the mountain slope to a 272 t truck loading bin at the mountain top. Trucks then haul the refuse into the valley where it is spread and compacted. This system replaces two aerial tramways which were supplemented by truck haulage.

4. CONCLUSIONS

HAC®s have found wide use in the marketplace. The system has proven to be very versatile with widely varying applications. Furthermore, HACs have proven their suitability for applications from underground mines to prep plant and beyond. The possibilities with HACs are far from being fully exploited. This continues to make for a bright and exciting future.

5. REFERENCES

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TABLE 1. High Angle Conveyor - HAC® Installations - Continental Conveyor & Equipment Company

	COMPANY / LOCATION	MATERIAL	RATE (t/h)	CONVEYING ANGLE (°)	ELAVATING HEIGHT (m)	LENGTH (m)	BELT WIDTH (mm)	BELT SPEED (m/s)	DRIVES (kW)		IN OPERATION
									TOP	BOTTOM	
1.	Demo unit / Winfield, AL, USA	Various	To 2903	30 to 60	7.9 to 19.5	35.0	1524	0 to 6.1	75	112	1983
2.	Triton Coal Co. / Gillette, WY, USA	Coal	2540	60	32.9	56.7	1524	5.33	149	224	1984

3.	Majdanpek Mine / Yugoslavia	Copper ore	4000	35.5	93.5	173.7	2000	2.67	450	900	1992
4.	Coal Company / Western USA	Coal	2903	35	29	61.9	1829	4.57	149	224	1987
5.	Granite Constr. Co. / LA, CA, USA	Excavated earth	272	90	31	39.9	914	1.6	22.4	22.4	1988
6.	Waste Treatment Co. / NY, USA	Sludge	.272	90	3.66	8.6	610	0.3	0.0	2.2	1989
7.	Boise Cascade / Wallula, WA, USA	Wood chips	173	53	32.6	49.3	1219	2.03	22.4	22.4	1989
8.	Coal Prep Plant / Eastern USA	Raw coal	1089	49	21.9	40.2	1372	2.79	56	56	1990
9.	Beth Energy Mines / Van, WV, USA	Clean coal	726	90	76.2	90.2	1372	2.79	112	112	1991
10.	Boise Cascade / Steilacoom, WA, USA	Wood chips	65.3	90	15.5	31.4	914	2.03	7.5	7.5	1991
11.	Valley Camp of Utah / Helper, UT,USA	Raw coal	1089	65	30.7	44.2	1372	3.56	93.2	93.2	1990
12.	Island Creek Corp. / Oakwood, VA, USA	Coal refuse	454	To 41	174.8	454.2	914	2.34	186	186	1992
13.	Steel Cement Ltd. / Australia	Gypsum, slag	50	90	16.2	37.8	600	1.67	7.5	7.5	1991
14.	Kimberly Clark / Canada	Wood chips	229	53	22.9	40.5	1219	2.03	18.6	18.6	1991
15.	Cape May County /	Compost	40.3	90	9.0	17.5	762	1.27	0.0	11.2	1991

	NJ, USA										
16.	Cape May County / NJ, USA	Compost	40.3	90	13.0	31.8	762	1.27	0.0	11.2	1991
17.	Shipping Company / Mexico	Grain	584	90	18.9	27.4	1524	4.06	56	56	1991
18.	Shipping Company / Mexico	Grain	1361	90	22.0	181.0	1829	4.06	112	112	1993
19.	Coal Company / Eastern USA	Clean coal	544	90	16.1	69.4	1372	2.79	37.3	75	1991
20.	Shipping Company / Mexico	Grain	907	65	30.7	44.2	1372	3.73	75	75	1993
21.	Gleason-Pequiven / Venezuela	Phosphate Rock	668	-35.5	Drop 34.0	113.0	914	2.29	0	93.2	1992
22.	Cementos Veracruz / Mexico	Hot Clinker	715	35	41.3	198.9	1219	1.73	56	112	1992
23.	Midwest Conveyor / FL, USA	Coal	1814	48	14.2	57.0	1829	3.56	75	112	1992
24.	U.S. Gypsum / NY, USA	Gypsum Rock	363	90	36.6	48.5	1067	1.52	37.3	37.3	1992
25.	The Conveyor Co. / WI, USA	Sludge	9.1	90	6.5	15.6	610	1.22	0.0	/7.5	1992
26.	Mountain Coal Co. / CO, USA	Raw Coal	1361	51	22.6	44.2	1524	3.56	75	93.2	1992
27.	Mountain Coal Co. / CO, USA	Raw Coal	272	35	15.0	37.5	1219	1.27	11.2	14.9	1992
28.	Taulman Systems / Canada	Compost	81.6	90	20.0	36.3	762	1.78	11.2	11.2	1992
29.	Montague Systems / WY, USA	Coal	1950	57	59.4	90.8	1829	3.66	186	298	1993
30.	Turns Coal Co. / IL, USA	Coal	1361	90	102.0	113.0	1524	4.57	298	298	1993
31.	Sasol / South	Coal	400	90	13.3	39.3	1200	2.2	30	30	1993

	Africa										
32.	Sasol / South Africa	Coal	400	90	13.3	40.3	1200	2.2	30	30	1993
33.	Sasol / South Africa	Coal	400	90	13.3	43.4	1200	2.2	30	30	1993
34.	Sasol / South Africa	Coal	600	90	13.3	40.3	1350	2.6	45	45	1993
35.	Sasol / South Africa	Coal	600	90	13.3	40.3	1350	2.6	45	45	1993
36.	Bechtel / NV, USA	Gold Ore	689	60	28.9	58.4	1219	1.65	37.3	56	1993
37.	Perini / MA, USA	TBM Muck	1266	90	70.1	83.8	1372	3.56	186	186	1993
38.	Palm Beach Resource / FL, USA	RDF	45.3	45	23.8	40.2	1372	1.15	0	15	1993
39.	Colver Power Plant / PA, USA	Coal	260	55	28.3	60.4	762	2.29	22.4	22.4	1994
40.	Colver Power Plant / PA, USA	Coal	260	To 60	46.9	78.9	762	2.29	30	37.3	1994
41.	Butterley Eng. / U.K.	Various	To 50	90	9.0	11.3	500	2.5	3	3	1993

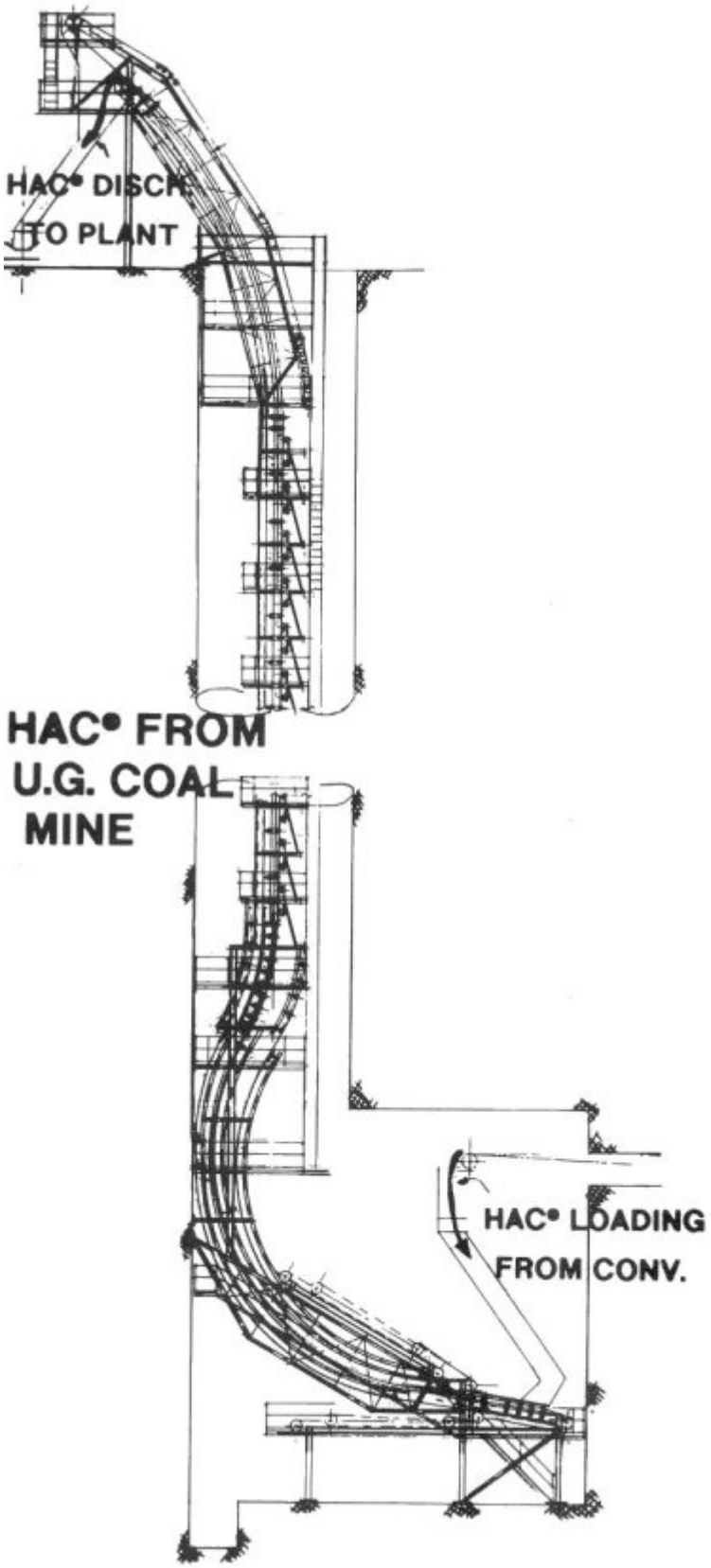


Fig 1: Vertical coal haulage from undergroung by HAC®

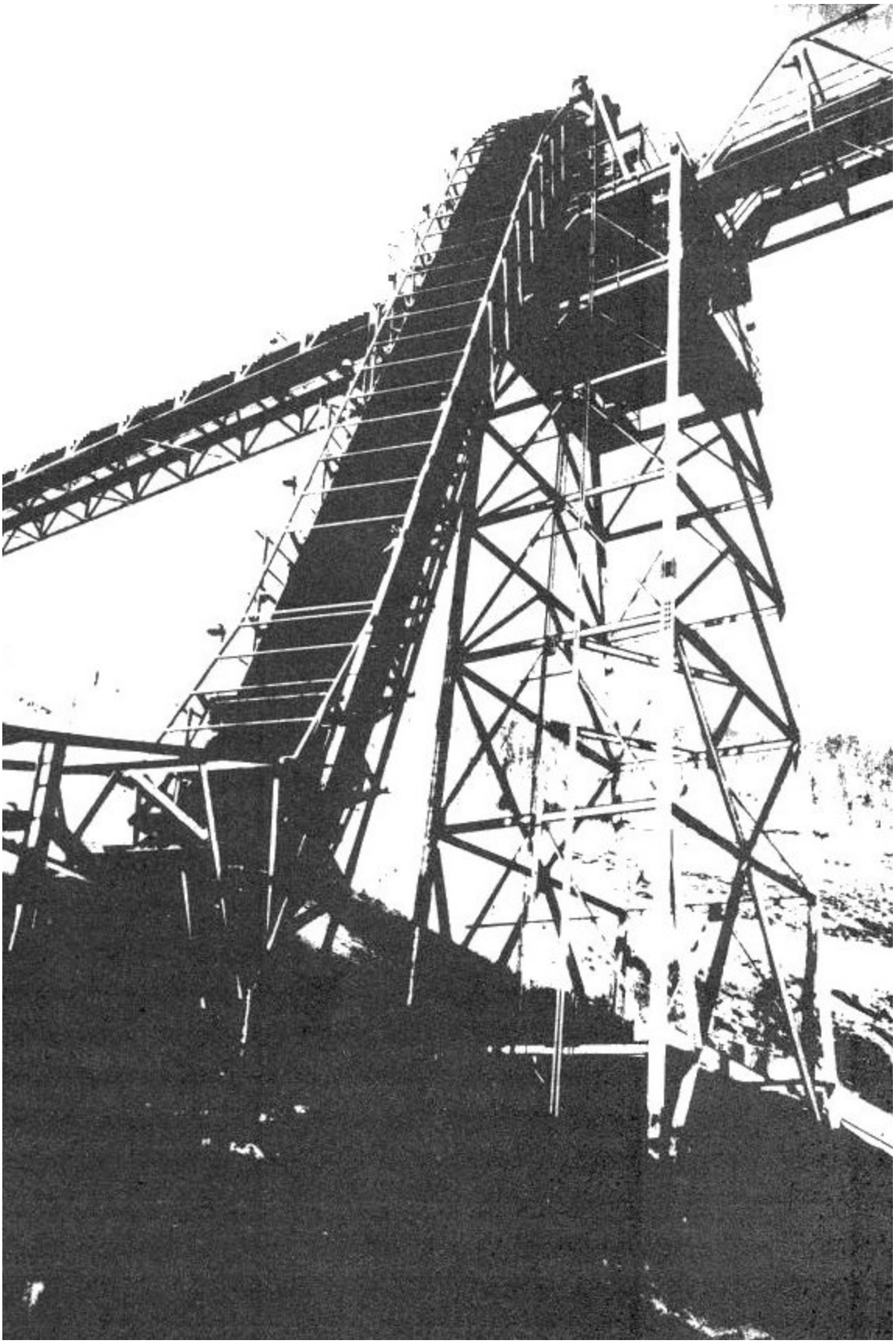


Fig 2: Raw coal haulage from U.G. slope belt

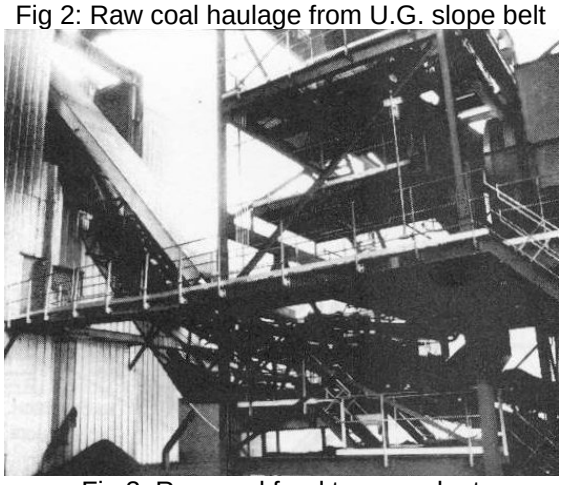


Fig 3: Raw coal feed to prep plant

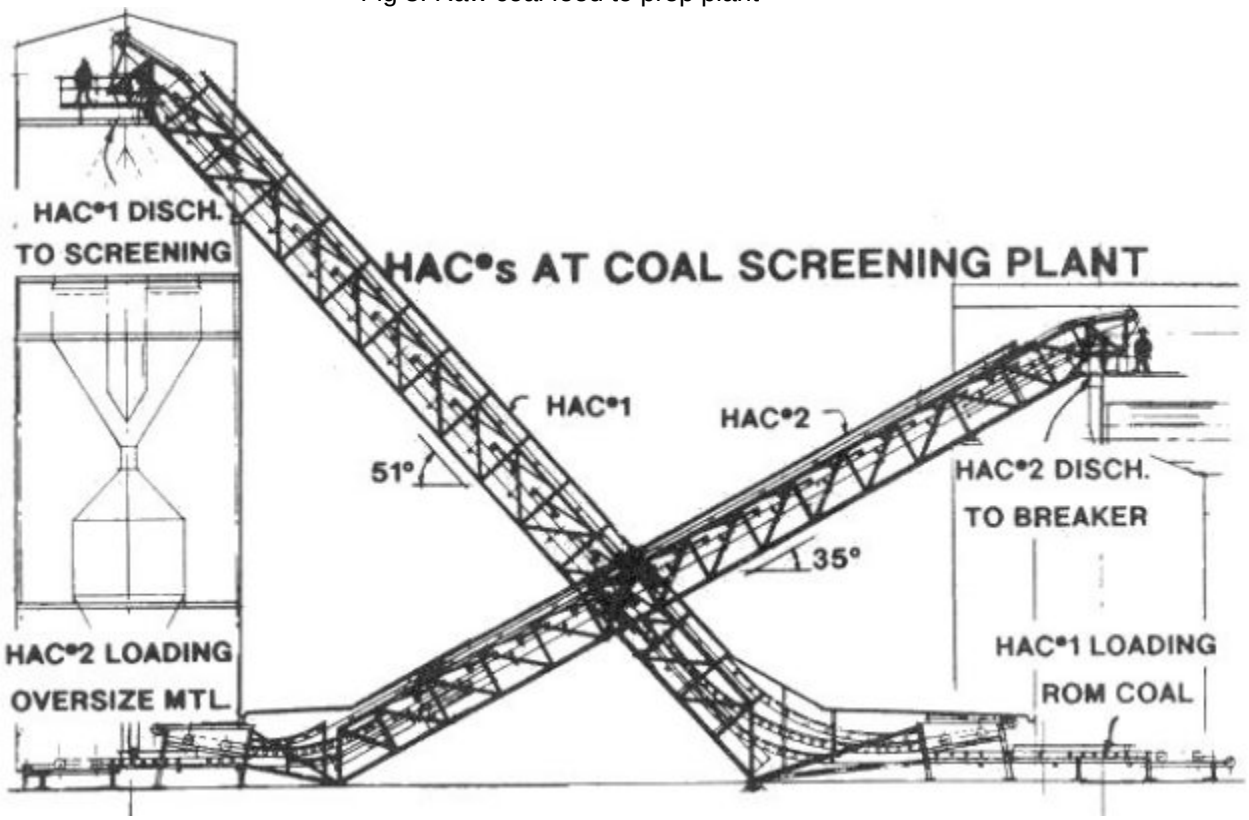


Fig 4: HAC®s for coal crushing and screening

Fig 5: 60° HAC®, cola, to train loadout silos

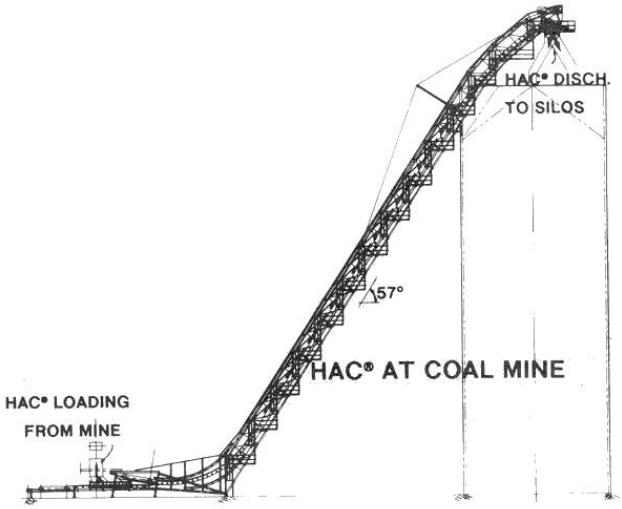


Fig 6: HAC® to coal silo

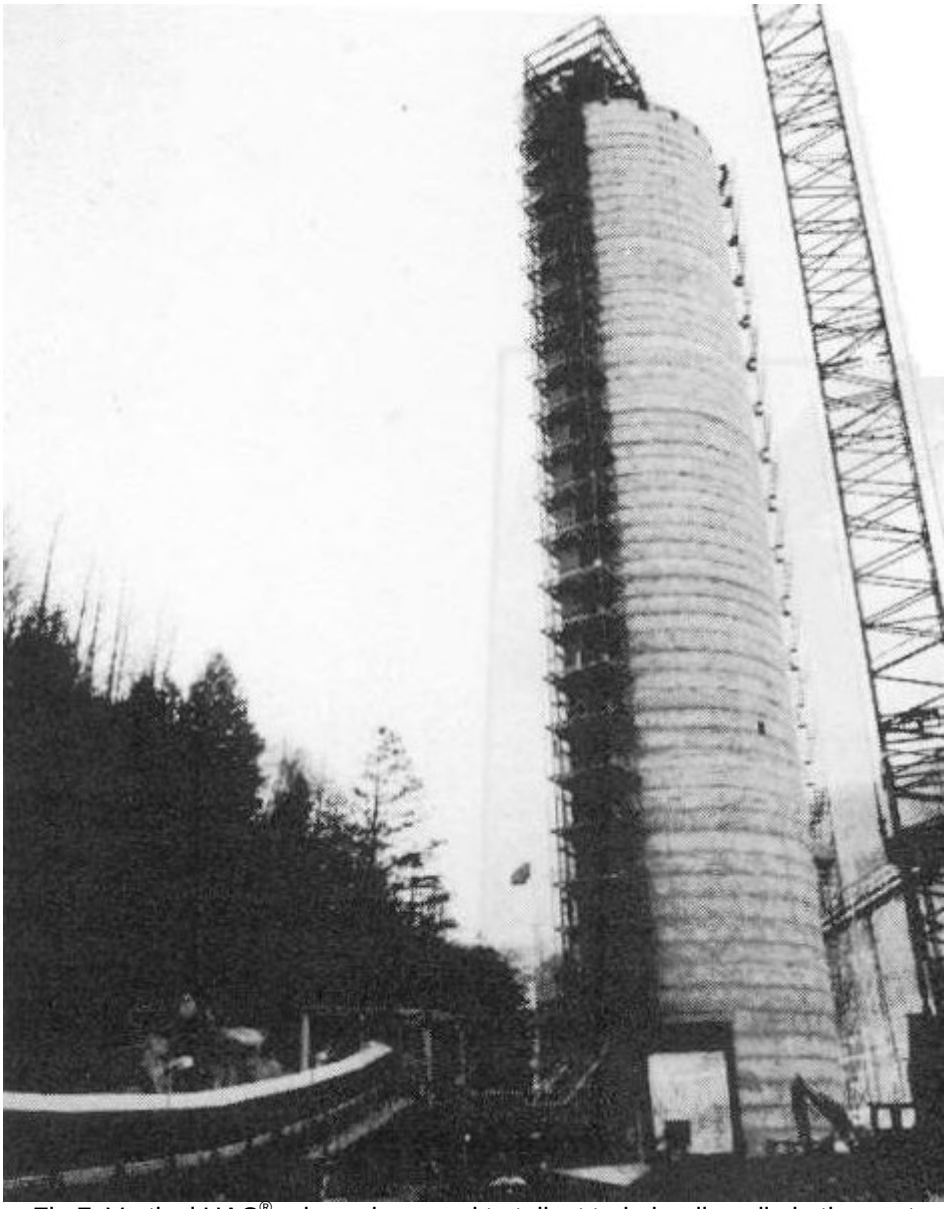


Fig 7: Vertical HAC® raises clean coal to tallest train loading silo in the east

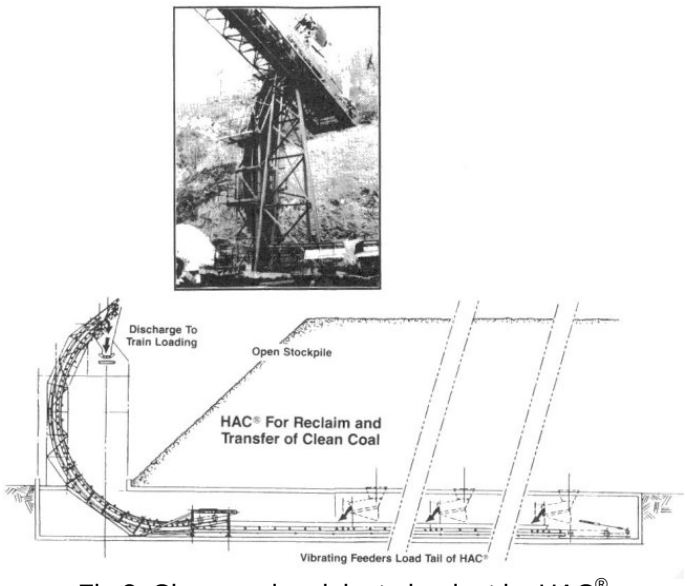
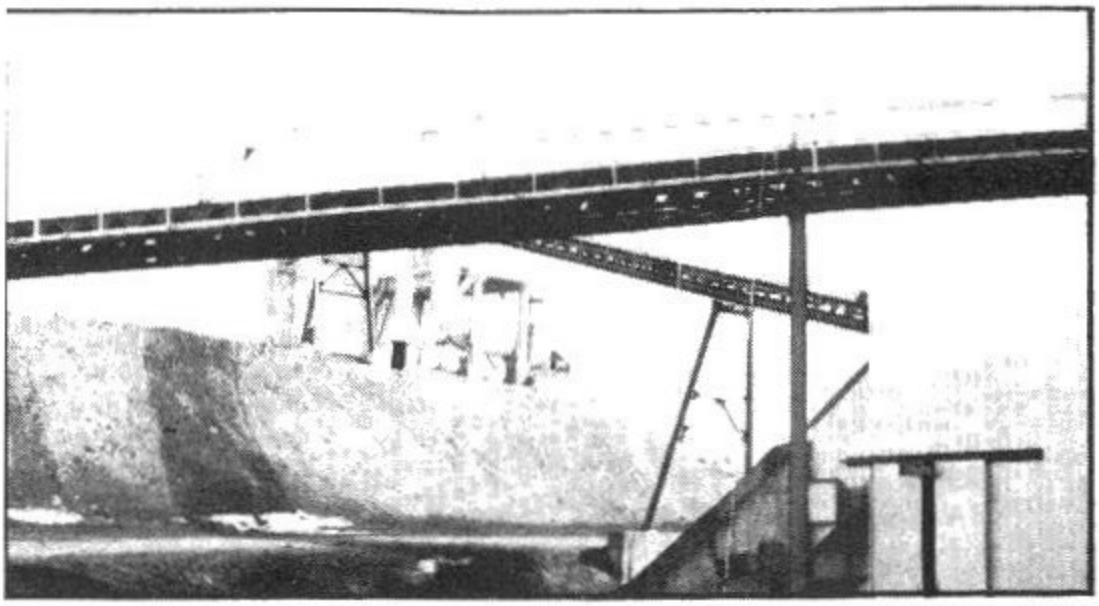
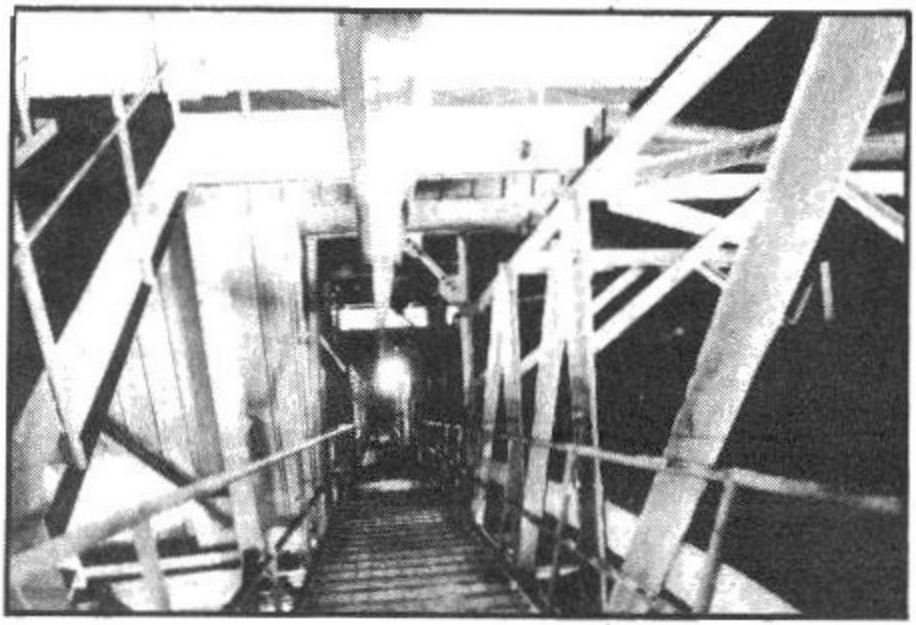


Fig 8: Clean coal reclaim to loadout by HAC®





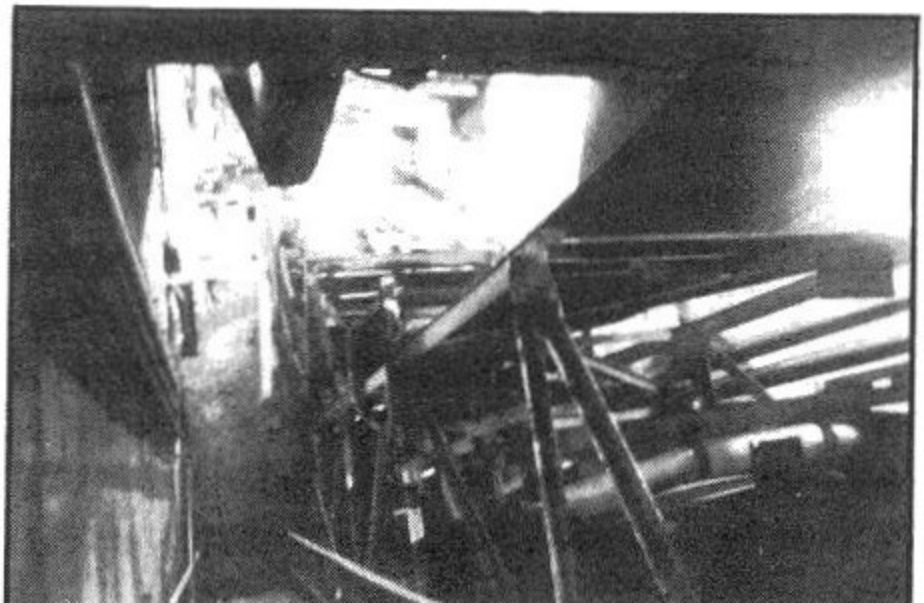


Fig 9: U.G. HAC® from coal storage barn to loadout

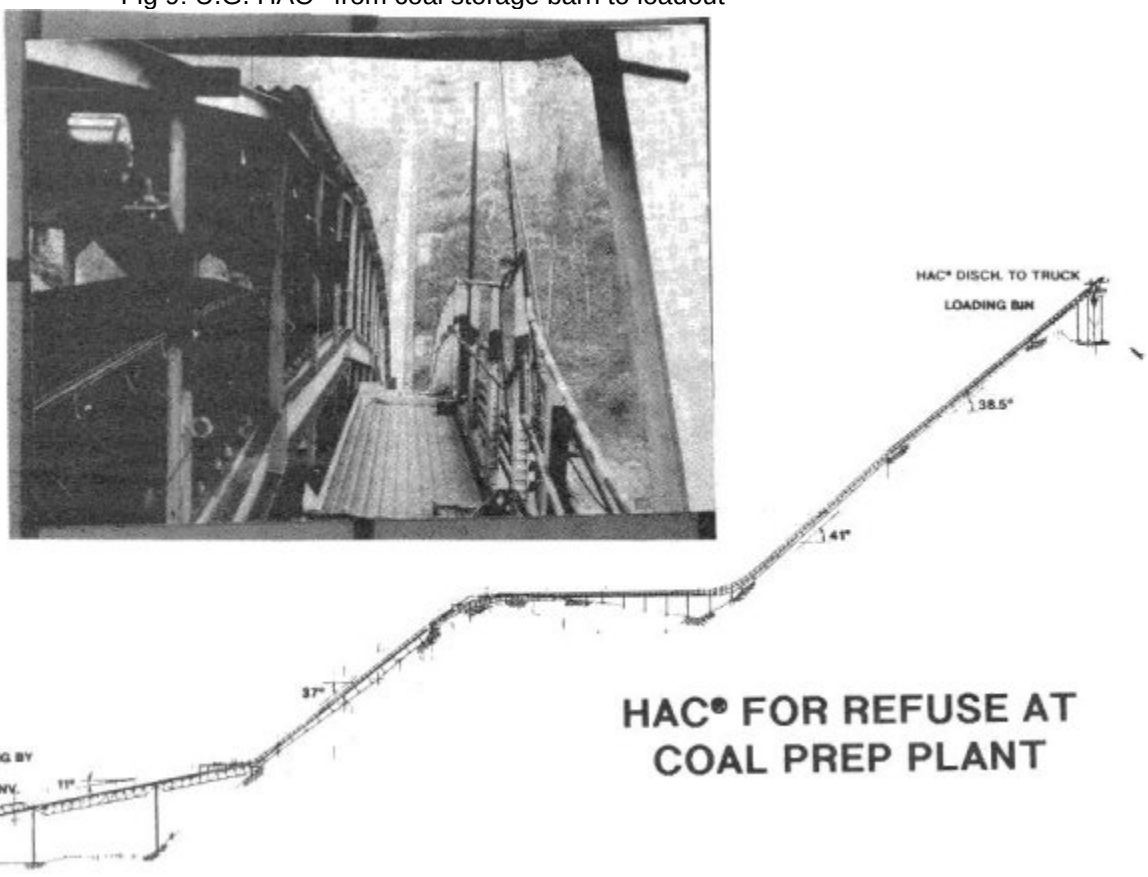


Fig 10: Refuse haulage over mountain face