

NO.	Project Name	Background	Demand Description	Expected Outcomes
		(1) The currently constructed small AI models for scene	Based on the development needs of highly intelligent mining,	(1) 1 set of multimodal data sample library for
		applications lack the ability to represent general data features:	we will make full use of the multi-source perception	underground coal mines;
		there are many models for one scene, which cannot support	heterogeneous data of the working face to build a multi-modal	(2) 1 set of multimodal basic large model for working
		multi-type and multi-task scene AI applications;	large model system for the fully mechanized working face.	faces;
		(2) The currently constructed small models for scene	We will form a multi-modal perception basic model for the	(3) No less than 30 scene application AI models built
		applications have weak generalization capabilities. For different	working face with high generalization, high precision and	based on the basic large model;
		scenes, a large amount of new scene sample data needs to be	high perception.	(4) 1 set of visual enhancement perception model for
		added for multiple model training to ensure the effect; and as the	(1) A multi-modal perception data sample library with a scale	underground coal mines.
		production process of the working face progresses, the	of no less than 10 million groups;	
		environment continues to change, the model accuracy decreases,	(2) A multi-modal perception basic model with the ability to	
		and the application effect deteriorates. It is necessary to	represent the features of video, image, point cloud and coal	
		continuously update the model training to ensure the on-site	mining process data. One basic model supports multiple types	
		application effect, thereby increasing the cost of engineering	of AI tasks;	
		application;	(3) The number of scene application models built based on the	
		(3) At present, the AI model of intelligent application uses two-	multi-modal perception basic model is no less than 30. Under	
	Research and application of	dimensional video images as the data basis and cannot reliably	the condition that the number of scene annotation samples	
1	basic model of multimodal	perceive the three-dimensional spatial scene information of the	required in the construction process is reduced by 70%, the AI	
	perception of working face	working face scene and the three-dimensional structure	application task effect of the application model can achieve	
		information of the equipment. It is difficult to achieve three-	the same accuracy level;	
		dimensional detection and recognition of target objects in the	(4) A visual enhancement diffusion model integrating	
		working scene space, as well as spatial measurement	multiple visual enhancement tasks such as denoising,	
		capabilities, and cannot provide perception result information	defogging, completion and super-resolution is built.	
		for scene space digitization;		
		(4) At present, scene AI applications are purely based on visual		
		perception applications, and artificial intelligence has not played		
		a strong role in the intelligent control process of coal mining."		



NO.	Project Name	Background	Demand Description	Expected Outcomes
		The application prospects of long-distance, large-volume	1. CCTEG duty: responsible for designing the overall layout	1. Expected outcomes of the project: complete set of
		pipeline coal transportation technology for coal-fired power	and structural form of the easy-to-sediment coarse particle	equipment, easy-to-sediment coarse-particle coal slurry
		scenarios are broad. In order to improve the economic benefits	mixing equipment, designing the transmission mode and	stirring device.
		and competitiveness of pipeline transportation, it is planned to	support structure of the mixing system, and manufacturing,	2. Technical indicators: For easy-to-sediment coarse-
		use slurry pipelines to transport high-concentration coal slurry	assembling and testing the tank and accessories.	particle coal slurry (weight concentration 60%~65%,
		containing 6mm coarse particles. However, there is currently no	2. Partner duty: responsible for the dynamic simulation and	average particle size 0.6mm, maximum particle size
	F 4	mature technology internationally for the stirring device for	model establishment of the mixing equipment in the high-	6mm and proportion greater than 13%), achieve a stirring
2	Easy-to-sediment coarse-	coarse-particle coal slurry particles, and the coarse particles	concentration coal slurry flow field environment of 6mm	effect with a concentration difference of ${\leq}1\%$ between
2	particle coal slurry stirring	cannot be effectively stirred, which poses the risk of silting up	coarse particles, and evaluating the suspension effect and	the upper and lower parts of the stirring storage
	device	the stirring tank and clogging the line pipeline. At the same time,	turbulence intensity of slurry particles under different speeds,	equipment.
		because the coarse-particle coal slurry settles faster than	blade structures and mixing methods.	
		conventional coal slurry, a faster stirring speed is required,		
		which will cause faster wear of the blades. Therefore, it is		
		necessary to tackle the core technologies of the stirring device,		
		such as blade design and manufacturing, and optimization of the		
		internal flow field of the tank.		



		During the underground coal mining process, the traditional	This project aims to cooperate with international institutions	1. Panoramic 3D reconstruction algorithm model The
		monitoring method has limited viewing angles, incomplete	with leading levels in panoramic video understanding and	external party will design and implement a panoramic
		information, delayed updates, and can only provide flat video	reconstruction technology to develop a real-time dynamic 3D	video-driven deep learning 3D reconstruction algorithm
		images, which is difficult to meet the needs of intelligent mining	reconstruction system based on panoramic video acquisition.	that can operate stably in complex mine environments
		for real-time dynamic monitoring. Panoramic video 3D	1. Partners are responsible for:	with high dust and low light. This method must be able
		reconstruction technology can break through these bottlenecks	(1) Multi-view panoramic reconstruction method: Research	to adopt a panoramic geometric consistency optimization
		and reconstruct the mining face environment in an all-round,	multi-view fusion methods to improve the spatial consistency	strategy to ensure 360° environmental perception
		real-time and accurate way, allowing coal mining technicians to	of panoramic videos and make the reconstructed 3D scenes	without blind spots.
		fully understand the actual mining environment as if they were	more complete and realistic;	Algorithm model performance indicators:
		"in the mine". At the same time, the system supports real-time	(2) Real-time dynamic update technology: Develop efficient	(1) Depth reconstruction error $\leq 2\%$;
		dynamic updates to ensure that the monitoring images change	data stream processing and optimization strategies to ensure	(2) Panoramic geometric consistency error ≤ 2 pixels;
		synchronously with the mine site, greatly improving the safety,	that the system can be updated in real time and achieve	(3) Global visual fidelity \geq 90%.
		operational efficiency and emergency response capabilities of	accurate environmental perception and dynamic	2. The foreign party will provide a GPU-based real-time
		the mine. The system enables coal mining teams and dispatch	synchronization;	3D reconstruction calculation and display prototype
		room personnel to grasp real-time data at any time, make quick	(3) Core algorithm research and development: Optimize deep	system for the trial production/prototype system.
	Dynamic Real-Time 3D	decisions, improve operational efficiency, and enhance the level	learning-driven 3D reconstruction algorithms for complex	System performance description and indicators:
3	Reconstruction System for	of intelligence.	mining environments such as high dust and low light to	(1) High dynamic scene adaptability;
3	Coal Mining Face Based on	The technical breakthroughs and innovations to be achieved	improve modeling accuracy and robustness;	(2) Support \geq 20FPS real-time panoramic 3D information
	Panoramic Video	include:	(4) Development of 3D reconstruction system: Integrate the	update;
		1. Panoramic stereo modeling to completely restore the mine	above algorithms and advanced technologies to develop and	(3) Meet the real-time requirements of coal mine
		environment	provide a complete prototype system.	monitoring;
		(1) Wider coverage: Traditional cameras have limited	2. CCTEG is responsible for:	(4) Adaptive optimization algorithm, which can
		monitoring range, while panoramic video combined with 3D	(1) Overall system architecture design and deployment: Based	dynamically adjust reconstruction parameters according
		reconstruction can provide complete mine environment	on the project objectives, cooperate with foreign parties to	to environmental changes to enhance system robustness.
		modeling;	develop the overall system architecture to ensure efficient	3. Research report and complete algorithm system
		(2) Clearer images: Intelligent algorithm optimizes	coordination of software and hardware components and	(1) Research report & technical documentation The
		reconstruction, and can still present stable and clear 3D images	compatibility with the existing coal mining face visual	foreign party will submit a panoramic 3D reconstruction
		even in high dust and low light environments.	monitoring system;	technical report, detailing the core technical principles,
		2. Immersive visual experience, improving the level of	(2) Data acquisition and processing: Carry out panoramic	key algorithms and experimental results;
		intelligent monitoring	video data acquisition in the actual mining environment, build	(2) The partner will cooperate in the mine environment
		From "watching videos" to "being there": Traditional monitoring	an experimental platform, and pre-process and annotate the	adaptability test and provide a detailed report to verify
		can only provide flat videos, while 3D reconstruction allows	collected data to support algorithm optimization and model	the reconstruction accuracy and stability of the system in
		managers to perceive the working face conditions in a panoramic	training.	high dust, low light and high dynamic environments;
		way, just like being there in person.	(3) Application verification and performance evaluation:	(3) The partner will provide detailed technical interface



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		3. Real-time dynamic updates, accurate presentation of the	Combined with the visual monitoring needs of coal mining	documentation to ensure that the system is scalable and
		mining process	faces, carry out underground tests and system performance	easy to connect with the company's existing intelligent
		Traditional 3D modeling updates slowly and cannot meet the	evaluation to verify its real-time, accuracy and robustness,	mining platform.
		rapidly changing needs of mine mining. The system will develop	and provide a basis for subsequent promotion and application.	
		AI-driven panoramic cloud reconstruction technology to ensure		
		that the monitoring screen is synchronized with the actual		
		working face mining dynamics.		
		(1) Safety management: Safety monitoring and early warning	(1) Present a complete virtual working face environment in an	(1) Algorithm model for holographic data analysis of
		are not intuitive. Safety management level can be improved by	immersive way;	working surface;
		simulating dangerous scenarios, displaying monitoring data in	(2) Replay abnormal situations that occur during the process	(2) Interactive software for replaying and previewing
		real time, and conducting drills.	execution through 3D visualization;	working surface processes.
		(2) Production management: Production process optimization	(3) Interactive operation facilitates training. The immersive	
		lacks a global perspective, equipment maintenance and	space allows trainees to more intuitively understand the	
		management efficiency is low, and remote collaborative working principle and automation p	working principle and automation process of the fully	
		command is difficult. With the help of holographic projection to	mechanized mining equipment;	
	Holographic Real-Time	display production processes and equipment models, remote	(4) Based on the coal seam geological data, a working face	
4	Projection Laboratory	collaboration can be achieved to improve production	simulation model is constructed to predict the appearance of	
-	Platform Construction	management efficiency.	roof coal pressure and rehearse measures and effects.	
	r lation in Constituction	(3) Personnel training: Operation skills training lacks real		
		scenes, and employees have difficulty in understanding		
		underground space. Use virtual operating environment and		
		roaming functions to improve employee skills and adaptability.		
		(4) Working face pressure early warning prediction: The early		
		warning prediction of the working face roof and coal seam		
		pressure lacks data analysis, prediction and real-life display. Use		
		the holographic projection platform to improve the application		
		effect of working face pressure early warning prediction.		



NO.	Project Name	Background	Demand Description	Expected Outcomes
		Components such as gear rings are the key parts for realizing	In order to improve the performance of core components such	Outcome 1: Solve the heat treatment deformation control
		power transmission of coal mining machines. Their surface layer	as shearer gear rings and extend their service life, the	issues that have been solved before the production of
		needs to have good wear resistance, fatigue strength and	chemical heat treatment process was studied by combining	core components such as coal machine gear rings;
		hardness, while the core must ensure good toughness and impact	experimental-theoretical-computational methods. First, a	Outcome 2: Use artificial intelligence to propose a
		resistance. In order to meet performance requirements, chemical	multi-scale coupling model of low alloy steel surface heat	method for optimizing the carburizing and quenching
		heat treatment processes such as deep carburizing technology	treatment based on the temperature-diffusion-phase change-	process:
		are often used to modify the surface of heavy-duty gear rings and	stress multi-physics field coupling theory was established.	Outcome 3: Establish an intelligent heat treatment
		annular gears. However, the main problems with deep	The model introduced the inelastic constitutive equation and	simulation system for core components such as coal
		carburizing at present are excessive carburizing time and large	considered the influence of factors such as thermal strain,	machine gear rings based on large language model
	Collaborative Control	quenching deformation. Excessive carburizing time not only	phase change induced strain and diffusion induced strain.	integration.
	Mechanism of Heat Treatment	affects the delivery cycle, but also causes more energy	Secondly, the model was embedded in the heat treatment	Outcome 4:
5	Deformation and Intelligent	consumption; large quenching deformation will increase the	simulation software COSMAP to realize the simulation	(1) Develop 1 set of intelligent optimization software for
5	Process Ontimization for Coal	workload of workpiece shaping and affect the surface	calculation of carbon diffusion and iron-carbon phase	carburizing and quenching process of gear rings;
	Machina Coar Bings	performance of the workpiece.	transformation process under different heat treatment process	(2) Apply for 1 software copyright; 2-3 patents
	Machine Gear Rhigs		parameters, and predict the residual stress and deformation of	(including 2 invention patents);
			gear steel during carburizing and quenching. Furthermore, a	(3) Training: Train 1-2 technical personnel for CCTEG.
			multi-objective process optimization system for carburizing	
			and quenching process under small sample conditions was	
			established by machine learning methods, and a gear steel	
			heat treatment process recommendation system based on a	
			large language model was developed. Intelligent process	
			parameter recommendations were made for heat treatment	
			processes such as carburizing to achieve process optimization	
			of heat treatment processes.	



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		In underground or on open-pit coal mines processes, large-scale	1 Material design and preparation: Combined with the special	1. Deliverables: Magnetorheological fluid material
		mining electromechanical equipment (such as mining	environment of coal mines (high humidity, high dust,	formula and preparation process. (Partner)
		machinery, underground transportation equipment, support	corrosiveness), the formula and preparation process of	Technical indicators: Stability of magnetorheological
		systems, etc.) are often in complex vibration conditions (high	magnetorheological fluid with stable performance and long	fluid in high temperature (\leq 80°C), high humidity (\geq 95%
		frequency, low frequency, strong impact, weak vibration, etc.),	life are studied.	RH), and high dust environment (service life \geq 3 years);
		which not only causes fatigue damage to key components,	2 Intelligent control system development: Using sensors and	yield strength of magnetorheological fluid ≥ 30 kPa
		increased failure rate, and increased maintenance costs, but also	intelligent control algorithms, by controlling the magnetic	(magnetic field strength ≥ 0.5 T); response time of
		easily causes unstable equipment operation and safety hazards.	field strength of the shock absorber, the real-time monitoring	magnetorheological fluid ≤20 ms.
		Therefore, vibration reduction devices need to be able to adjust	and dynamic adjustment of the magnetorheological fluid	2. Deliverables: Intelligent control system hardware and
		intelligently to adapt to complex vibration conditions. Most of	vibration reduction system are realized to ensure the optimal	algorithm model. (Partner)
	Koy tochnologies of intelligent	the existing vibration reduction devices use passive solutions	vibration reduction effect under complex vibration	Technical indicators: control system response time ≤ 50
	magnetarheological vibration	such as spring-damping, which only have good vibration	conditions. (CCTEG provides equipment vibration	ms; support multi-sensor data fusion (vibration
6	reduction for complex	reduction effects under specific vibration forms, and cannot	conditions, and Partner develops control system hardware and	frequency range: 1 Hz~50 Hz).
	vibration conditions	adjust the damping force in real time according to the working	algorithm model)	3. Deliverables: Magnetorheological shock absorber
		conditions. The vibration reduction effect is not ideal under	3 Customized design, processing and test verification:	prototype suitable for underground coal mine
		complex vibration conditions, and it is difficult to meet the needs	According to the special environment of coal mines, the	environment. (CCTEG and Partner)
		of coal mine machinery and equipment for high reliability and	magnetorheological fluid vibration reduction system is	Technical indicators: maximum damping force of shock
		high stability in harsh environments.	customized and optimized. Design and processing, build a test	absorber \geq 5 kN; shock absorber operating temperature
			bench to verify the vibration reduction effect, and further	range: -20°C~80°C; shock absorber shock absorption
			optimize the material preparation and structural design.	efficiency under complex vibration conditions \geq 70%;
			Finally, the underground equipment is selected for trial	shock absorber life $\geq 10,000$ hours (in underground coal
			operation to verify the vibration reduction effect and	mine environment).
			engineering applicability of the system and provide a	
			technical basis for subsequent promotion and application.	
			(CCTEG and Partner)	



NO.	Project Name	Background	Demand Description	Expected Outcomes
		Coal rock impact tendency refers to the inherent property of	Through joint tests, test multiple parameters or indicators of	1. A set of standardized methods for coal and rock
		whether coal rock can produce rock burst, which is currently	coal rock physical mechanics, find characteristic indicators,	physical parameters; (both parties)
		mainly determined by mechanical testing. However, as an	and establish the relationship between the indicators and	2. A set of methods for identifying physical properties of
		inherent property of coal rock, how the characteristics or	impact tendency.	impact tendency; (both parties)
		behavior of the coal rock itself affect the impact tendency, how	(1)Carry out CT scanning, uniaxial compression, wave	3. A set of international standards for identifying impact
	Research on the correlation	to infer the impact tendency from the physical properties, and	velocity measurement and other testing of coal rock physical	tendency. (both parties)
7	between coal rock physical	then predict the impact hazard, these key core essential questions	mechanical parameters of different tendencies to form a coal	
/	properties and impact	have not yet been clearly answered. Therefore, it is necessary to	rock physical property data set; (CCTEG duty)	
	tendency	explain the essential causes of the impact tendency from the	(2)Carry out research on coal rock physical property data	
		perspective of coal rock physical properties, so as to formulate a	standardization methods and construct new methods for coal	
		classification and evaluation standard for coal rock impact	rock impact tendency discrimination standards; (Partner duty)	
		tendency and improve the impact tendency identification	(2)Carry out the application for international standards for	
		system.	coal rock impact tendency discrimination standards (jointly	
			by both parties)	



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		In confined spaces such as underground mine work sites and	In response to the urgent need for dynamic monitoring of gas	Completed the development of a prototype of mining gas
		enclosed industrial facilities on the ground, once disasters such	environments in limited spaces such as underground tunnels,	detection equipment based on laser detection technology,
		as gas outbursts, fire explosions or harmful gas leaks occur,	goafs, closed chambers, and ground industrial tanks and	achieving the functional requirements of non-contact
		rescue work will face multiple technical challenges: First, due to	pipelines, it is necessary to develop a gas advance detection	multi-gas synchronous detection, environmental
		the narrow space structure, secondary disaster risks and toxic	system based on tunable semiconductor laser absorption	parameter integration and lightweight.
		oxygen-deficient environment, rescue workers cannot safely	spectroscopy technology. The specific requirements are as	
		approach the core disaster area to conduct environmental	follows:	
		detection; second, existing detection equipment is inconvenient	1. Performance indicators	
		to carry, has low measurement accuracy and is complex to	(1) Non-contact long-distance detection: Using laser	
		operate, and cannot meet on-site needs.	spectrum scanning technology, synchronous quantitative	
			detection of gases such as methane, carbon monoxide, carbon	
			dioxide, and oxygen within a range of 20 meters is achieved.	
			(2) Multi-parameter integration: The equipment must	
			integrate temperature, humidity, and air pressure sensors to	
	Advanced and accurate		support multi-dimensional data correlation analysis of	
8	detection of gas in confined		environmental parameters and gas concentrations.	
	space		(3) Intelligent anti-interference capability: Built-in adaptive	
			filtering algorithm can suppress interference such as dust	
			scattering and water mist absorption.	
			2. Technical capabilities and delivery requirements of the	
			partner	
			(1) Technical capabilities: Experience in the development of	
			laser gas detection equipment (similar project cases and test	
			reports must be provided), and embedded system	
			development and wireless communication protocol	
			adaptation capabilities must be possessed.	
			(2) Delivery requirements: An integrated solution of	
			"hardware + software + data analysis platform" must be	
			provided, including: multi-parameter mobile portable device	
			prototypes and algorithm programs, and performance	
			indicators must meet the requirements.	



NO.	Project Name	Background	Demand Description	Expected Outcomes
		Explosion-proof testing and certification is a very important	"Carry out IECEx technical exchanges, study and discuss the	1 Report
		business of the institute. The explosion-proof standard	explosion pressure of flameproof enclosures and dynamic	
	IECEx technical exchange	GB/T3836 was modified to adopt the international IEC60079,	flameproof surfaces with ambient temperatures exceeding -	
		which resulted in a lack of understanding of the underlying	20°C to 60°C, the differences and concerns of different	
		reasons for some standard clauses. There were multiple different	methods for internal ignition non-transmission tests, carbon	
		understandings when the standard was implemented, and the	fiber composite explosion-proof enclosures, and the	nclosures, and the devices, and form a mical capabilities and of equipment used in ces between the three ds, and the impact of perties and explosion
		implementation was not smooth. The institute lacked the voice	installation of breathing and drainage devices, and form a	
		and influence in the international and China's explosion-proof	technical research report to enhance technical capabilities and	
		industries, and had less communication with the international	industry voice.	
		IECEx.	Issues to be discussed (1) For flameproof equipment used in	
			environments below -20°C, the differences between the three	
0	IFCE _x tashnigal ayahanga		reference pressure measurement methods, and the impact of	
,	IECEX technical exchange		low temperature on the material properties and explosion	Report
			resistance of the equipment. (2) For flameproof equipment	
			used in environments above 60°C, the differences between the	
			three non-explosion test methods, and the impact of high	
			temperature on the material and function of the equipment. (3)	
			The impact of dynamic flameproof surfaces (such as motor	
			shaft flameproof surfaces) on the non-explosion	
			characteristics of the equipment, and the considerations of the	changes, study and discuss the of enclosures and dynamic ient temperatures exceeding - 1 Report ient temperatures exceeding - is and concerns of different ion-transmission tests, carbon proof enclosures, and the frainage devices, and form a ance technical capabilities and in the frainage devices, and form a ance technical capabilities and flameproof equipment used in idifferences between the three int methods, and the impact of rial properties and explosion 2) For flameproof equipment ² C, the differences between the heads, and the impact of high 1 function of the equipment. (3) proof surfaces (such as motor) on the non-explosion t, and the considerations of the y of simulation and numerical ce and non-explosion tests. (5) is an output to the second surface is a second second surface is a second seco
			test methods. (4) The feasibility of simulation and numerical	
			calculation of pressure resistance and non-explosion tests. (5)	
			The differences between the three non-explosion test methods	
			for Class IIC equipment."	



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		The existing high-value utilization of coal gangue is mainly	(1) Some valuable elements are abnormally enriched in coal	(1) Using green and environmentally friendly process
		concentrated in building materials, low calorific value fuels,	seams in some parts of China. For example, the gallium	routes, conduct preliminary exploration of leaching
		engineering project repair materials, etc., with low economic	content in coal seams in Jungar mining area in Inner Mongolia	reactions of different coal gangues, and understand the
		value, and it is difficult to form a self-sufficient closed-loop	and Pingshuo mining area in Shanxi reached $70.0 \mu g/g$ and	influence of parameters such as acid leaching agent type,
		industrial chain. In some parts of China, coal gangue is enriched	$57.0\mu g/g$ respectively. The effective extraction of high-value	reaction temperature, and reaction pressure on leaching
		with high-value elements such as Co and Ga, but the resource	components in this type of specific coal gangue can	rate and leaching speed.
	Using sustainable technologies	utilization efficiency is low. How to extract high-value elements	effectively improve the economic value of resources, improve	(2) Select coal gangue samples with high extraction
	uithout generating new colid	such as Co and Ga from coal gangue in a green and	the existing industrial chain, and realize the high-value	added value, determine process parameters, and design
	without generating new sonu	environmentally friendly way is a problem that needs to be	utilization of coal gangue.	and build a small-scale continuous device with a daily
10	waste and environmental	solved urgently.	(2) The high-value element extraction method adopted by this	processing capacity of kilograms.
10	bigh value metal elements from	Solid waste disposal and comprehensive utilization are key	process has the advantages of not using inorganic strong	(3) Co-publish 1 English scientific paper and jointly
	mgn-value metal elements from	products of the institute. At present, there is still a blank in the	acids, reducing agents and other chemical substances; not	apply for 1 international invention patent.
	coal gangue and coal-based	extraction technology of high-priced elements, and the	generating secondary pollution and new hazardous waste;	
	solid waste	extraction technology of valuable components will improve the	weakening the acid corrosion effect, thereby greatly reducing	
		company's existing industrial chain and enhance the overall	the cost of the reaction device; short reaction time, high	
		economic value.	efficiency, and easy scale-up of continuous operation.	
			(3) Complete the technology migration and use it in the high-	
			value application of coal gangue, and the extraction rate of	
			high-value elements such as Co and Ga shall not be less than	
			90%.	



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		(1) Hydraulic support concentrate is widely used in the	(1) Design a biodegradable, low-cost solid nano-additive	(1) A set of solid nano-additive formulas, all additive
		transmission of coal mine comprehensive mining hydraulic	suitable for the hydraulic system of coal mine equipment, and	components such as lubrication, rust prevention,
		system, playing a role in lubricating and rust-proofing key	synthesize a highly stable and environmentally friendly	corrosion inhibition, and antifreeze are solid at room
		components. However, the existing hydraulic support	water-based nanofluid with excellent anti-wear, anti-rust, and	temperature, degradable in 28 days, and the total cost is
		concentrate has the problem of poor biodegradability. Since the	anti-freeze effects;	no more than 10 yuan/kg; the water-based nanofluid
	Development and application	coal mine comprehensive mining hydraulic system is a semi-	(2) Study the influence of various ions and impurity	synthesized based on solid nano-additives meets the MT
11	of new water-based nanofluids	closed system, accompanied by running, bubbling, dripping, and	components in mine water on the performance and stability of	76-2011 standard, the maximum non-seizure load PB
	for coal mine bydraulic systems	leakage, the existing hydraulic support concentrate will cause	nanofluids;	value is no less than 392 N, and the volume content of
	for coar mine nyuraune systems	serious water pollution and soil oiliness. Therefore, it is	(3) Carry out industrial tests of water-based nanofluids in the	liquid surface precipitation in 7 days is no more than
		necessary to develop a new type of environmentally friendly,	hydraulic system of underground coal mine equipment, and	0.1%.
		high-performance hydraulic transmission medium to replace the	optimize the design. (Completed by CCTEG)	(2) A set of research reports, revealing the influence of
		existing hydraulic support concentrate and solve the industry		various ions and impurities in mine water on the
		pain point of environmental pollution of coal mine hydraulic		performance and stability of nanofluids.
		system.		
		(1) The durability of the hydraulic end valve core and valve core	(1) Improve the surface performance of the valve core and	According to CCTEG needs and the relevant technical
		is low;	valve seat, and the service life shall not be less than 4000	support materials provided, our partners will provide a
		(2) The ceramic plunger is easy to break and the high-pressure	hours. After replacement, it must reach the same service life;	full set of technical solutions, including but not limited
		seal pair is easy to fail; (2) Strengthen the toughness of the ceramic plunger, and r	to technology selection, matching structure, material and	
		(3) The service life of the reduction gearbox oil seal is short;	cracking shall occur. The service life of the high-pressure seal	surface treatment process, etc.
	Research on key technologies	(4) The connection between the plunger and the crosshead slider	pair shall not be less than 2500 hours, and after replacement,	
	of hydraulic and and seal	is unreliable;	it must reach the same service life;	
12	reliability of low-noise high-	(5) The coupling elastomer is easily damaged;	(3) The service life of the rotary seal and reciprocating seal of	
12	nressure and high-efficiency	(6) The noise is too loud when the pump station is running.	the reduction box shall not be less than 3500 hours, and after	
	plunger numns		replacement, it must reach the same service life;	
	plunger pumps		(4) The connection between the plunger and the crosshead	
			slider is inherently safe and shall not fall off;	
			(5) The coupling shall not be damaged during the entire	
			service life;	
			(6) The noise value of the pump station during operation shall	
			not exceed 85 (dB).	



NO.	Project Name	Background	Demand Description	Expected Outcomes
		In order to ensure the coal supply of coal-fired power plants,	1. CCTEG duty: Responsible for designing the process flow	1. Expected results of the project: complete set of
		slurry pipelines are designed to transport coal point-to-point for	and structural form of the stable coal slurry high-efficiency	equipment, efficient dehydration device for stable coal
		power plants. However, under the current technical level, the	dehydration device, and manufacturing, processing, assembly	slurry.
		moisture content of the stabilized coal slurry after centrifugation	and testing of the dehydration device accessories.	2. Technical indicators: for stable coal slurry (weight
		and filter pressing is >20%, which is higher than the moisture	2. Partner duty: Responsible for dehydration device modeling	concentration 50%~55%, average particle size 0.37mm,
12	Stable coal slurry high-	requirement of the power plant ($\leq 12\%$), and reduces the thermal	and dynamic analysis, simulation of the stable coal slurry	particle size below 0.045mm accounts for about 20%),
15	efficiency dehydration device	efficiency of the unit, and cannot meet the moisture requirements	dehydration process, evaluation of the dehydration effect and	the comprehensive moisture content of dehydrated
		of the power plant. Therefore, it is necessary to tackle the core	pressure distribution under different drum structures and filter	products is $\leq 12\%$.
		technologies of the stabilized coal slurry dehydration device,	plate structures.	
		such as drum structure design, filter plate and filter cloth design		
		and manufacturing, pressure control technology, etc., to reduce		
		the moisture content of the product.		



NO.	Project Name	Background	Demand Description	Expected Outcomes
		Open-pit coal mine continuous/semi-continuous system	It is planned to cooperate in the development of a fault	The expected outcome is an intelligent fault diagnosis
		equipment failures occur frequently and are difficult to detect in	diagnosis and prediction system for open-pit coal mine	and prediction system designed for open-pit coal mine
		time. Existing monitoring methods are lagging behind, and	continuous/semi-continuous system equipment. The system	continuous/semi-continuous system equipment. The
		repairs are only carried out after the failure occurs, which not	needs to integrate real-time data collection, intelligent	system is provided by the partner with core algorithm
		only delays production progress but also increases maintenance	analysis, high-precision fault diagnosis and early warning,	models, software platforms, and detailed research reports
		costs. With the expansion of mining scale and aging of	and predictive maintenance functions. It aims to achieve real-	and documents to ensure a fault diagnosis accuracy rate
		equipment, the losses caused by failures are becoming more and	time monitoring and accurate prediction of equipment health	of \geq 95%, a warning lead time of \geq 72 hours, and a system
		more serious, seriously affecting production efficiency and	status through the Internet of Things, big data analysis, and	response time of ≤ 5 seconds. Through technology
		economic benefits.	artificial intelligence technology, so as to reduce unplanned	introduction, CCTEG will integrate the partners's
	Fault diagnosis and control of		downtime, reduce maintenance costs, improve operating	advanced technologies in the fields of Internet of Things,
	equipment in open-pit		efficiency, and ensure operational safety.	big data analysis, and artificial intelligence, and combine
14	continuous/semi-continuous		The partner is responsible for providing the development and	its own industry knowledge to jointly create a set of user-
	systems Research on prediction		optimization of Internet of Things data collection technology,	friendly, efficient and reliable solutions to improve
	technology		intelligent analysis algorithms, and prediction models to	equipment maintenance efficiency, reduce operating
			ensure that the system has the ability of high-precision fault	costs, and enhance operational safety.
			diagnosis (accuracy \geq 95%), long warning lead time (\geq 72	
			hours), and rapid response (\leq 5 seconds);	
			This unit will contribute in-depth understanding of the	
			operation process, historical fault data, and field application	
			experience to jointly ensure that the system has a fault	
			diagnosis accuracy of \geq 95%, a warning lead time of \geq 72	
			hours, and a system response time of ≤ 5 seconds, and form	
			an extensible expert knowledge base.	



NO.	Project Name	Background	Demand Description	Expected Outcomes
15	Precise control technology of emulsion cylinder for mining	The belt self-moving tail produced by CCTEG is a key equipment in the chute. Its pushing, lifting, and deviation adjustment are all dependent on emulsion cylinders, and the operation depends on manual labor. With the development of intelligent coal mines, the self-navigation and unmanned movement of the belt self-moving tail of the chute is the future development direction. At present, the control accuracy of the emulsion cylinder is poor and cannot meet the requirements of the equipment's self-navigation control accuracy. The oil medium cylinder can be accurately controlled by the servo valve, but due to the poor lubricity and corrosiveness of the emulsion, the servo valve has not been effectively used. Therefore, it is urgent to study the technology that can realize the precise control of the emulsion cylinder for mining	Research a technology that can achieve precise control of emulsion oil cylinders used in mines. This technology should enable the precise control accuracy of emulsion oil cylinders used in mines to reach mm level. This requirement aims to research a technology that can achieve precise control of emulsion oil cylinders used in coal mines.	A related technology that can achieve precise control of emulsion cylinders. Control accuracy index: ±5mm.



Rackground Domand Description

NO.	Project Name	Background	Demand Description	Expected Outcomes
NO.	Project Name Key technology of solid-liquid friction power generation in coal mine hydraulic system and development of low-energy consumption monitoring components	Background The current online monitoring methods of coal mine hydraulic systems are relatively simple, lacking effective detection of component-level status, especially for components such as rust, cavitation, valve port pressure, and emulsion contamination. The use of external sensors is not only large and bulky but also needs to be installed or attached to the equipment system, and relies on external power supplies, which poses challenges to the accuracy of sensor data, lightweight equipment, and long-life development. Therefore, it is urgent to develop a miniaturized, low-energy real-time, online oil monitoring sensor system; convert it into electrical energy through solid-liquid interaction and integrate the sensor device into the hydraulic components to realize fault monitoring of the support hydraulic system.	 Demand Description (1) Develop triboelectric materials with high durability, high chargeability and high resistance to oil adsorption, which are used for liquid-solid contact electrification to generate easily monitorable electrical signals at the volt level; (2) Reveal the charge transfer mechanism at the liquid-solid interface, clarify the mapping relationship between hydraulic component wear and liquid-solid contact electrification electrical output, and realize online monitoring of hydraulic component wear; (3) Develop a liquid-solid triboelectric self-powered pressure sensor integrated in hydraulic components to realize real-time monitoring of hydraulic valve port pressure; (4) Develop a liquid-solid triboelectric self-powered emulsion contamination monitoring sensor integrated in hydraulic and cleanliness. 	Expected Outcomes(1) A triboelectric material: lifespan, cycle period not less than 50,000 times, use for more than 5 years; electrification performance, volt-level signal; anti-oil adsorption, emulsion or lubricating oil contact angle not less than 150°, achieving super hydrophobicity and super oleophobicity.(2) A set of liquid-solid triboelectric wear monitoring devices, realizing online monitoring of hydraulic component wear, with wear monitoring accuracy not less than 90%;(3) A set of liquid-solid triboelectric self-powered pressure sensors, with a pressure detection range not less than 60MPa, an accuracy not less than 1%FS, and an output frequency not less than 10Hz;(4) A set of liquid-solid triboelectric self-powered emulsion contamination monitoring sensors, emulsion detection indicators: abrasive concentration <0.05 wt.%,
	components		contamination monitoring sensor integrated in hydraulic components to realize monitoring of emulsion concentration and cleanliness.	 output frequency not less than 10Hz; (4) A set of liquid-solid triboelectric self-powered emulsion contamination monitoring sensors, emulsion detection indicators: abrasive concentration <0.05 wt.%, abrasive size <50 μm. (5) The lifespan of all sensors provided is not less than 20,000 hours, meeting the requirements for underground use in coal mines.



NO.	Project Name	Background	Demand Description	Expected Outcomes
		At present, permanent magnet drive technology is becoming	Taking the 1000kW permanent magnet direct-drive motor for	Research report, overall technical solution, digital
		more and more mature. Permanent magnet direct drive has been	scraper conveyor as an example, key technology research	prototype and process package for manufacturing the
		successfully applied on belt conveyors, and there are also cases	such as principle structure, power density and efficiency, and	prototype of permanent magnet direct drive motor for
		of successful application of permanent magnet semi-direct drive	control strategy is carried out to form a complete permanent	scraper conveyor. Evaluation indicators (taking 1000kW
		on scraper conveyors. Permanent magnet direct drive has the	magnet direct-drive motor research and development and	permanent magnet direct drive motor as an example):
		advantages of high efficiency, energy saving, environmental	production technology system that can adapt to the	(1) Rated voltage: 3300V; rated output speed: about
	Key technology of permanent	protection, simple system, and easy maintenance, and has broad	installation space and operating conditions of scraper	46r/min; rated output torque: 207kN•m; starting torque:
17	magnet direct drive motor for	application prospects in the field of coal mine automation. At	conveyor.	≥456kN•m;
	scraper conveyor	present, due to the limitations of scraper conveyor installation		(2) Overall dimensions (length×width×height)
		space and operating conditions, there are no cases of successful		≤1450mm×1100mm×1340mm (excluding inverter);
		application of permanent magnet direct drive on scraper		(3) Adaptable to inverter. With inverter, high-precision
		conveyors. As a key core component of scraper conveyors,		automatic vector control speed regulation can be
		motors have a great impact on the performance improvement		achieved, and stable operation can be achieved at a
		and intelligence level of scraper conveyors, and can enhance		minimum of 0.75r/min;
		CCTEG's market competitiveness.		(4) Built-in brake, braking torque not less than 725kN•m.
		As a key component of scraper conveyors and transfer machines,	1. Develop a raw material for a light mining chain with a	1. Raw materials for light mining chains;
	Raw materials and key chain manufacturing technology for light mining chain	mining chains play the role of transmitting power and outputting	material density of $\leq 4g/cm^3$ and material performance	2. Key chain manufacturing technologies for raw
		coal and are used in large quantities in underground coal mine	indicators not lower than the 23MnNiMoCr54 material	materials for light mining chains, such as weaving,
		working surfaces. At present, the raw materials used in the	specified in GB/T10560-2017 "Steel for high-strength round	welding, 3D printing, etc.;
		production of mining chains are generally alloy steel, and there	link chains for mining", with yield strength ≥ 1060 Mpa,	3. Ø38~Ø60 light mining chain products.
		are problems such as heavy weight and difficulty in	tensile strength \geq 1180Mpa, and impact AKv \geq 60J.	
		transportation during the production process. Especially in the	2. The performance of the light chain manufactured using new	
18		environment of limited working space on the underground	materials and key chain manufacturing technologies (such as	
10		working surface, the long length and heavy weight of the product	braiding and welding technology, 3D printing technology,	
		properties make the transportation, laying, installation and	etc.) shall not be lower than the technical requirements of	
		replacement of mining chains very difficult, resulting in	GB/T12718-2009 "High-strength round link chains for	
		problems such as high labor intensity, low production efficiency	mining", and at the same time, it shall have wear resistance	
		and high safety risks.	and underground corrosion resistance not lower than the same	
			type of steel chains. The price of light chain products shall not	
			exceed 3 times that of the current steel chains with the same	
			specifications.	



NO.	Project Name	Background	Demand Description	Expected Outcomes
19		The switched reluctance motor has the characteristics of low	Design a high-power mining flameproof switched reluctance	The design and manufacturing technology of high-power
		speed, high torque, high efficiency, high temperature resistance,	motor for scraper conveyor, which can be used in	flameproof switched reluctance motor for mining. Motor
		vibration and impact load resistance, and can start smoothly with	environments with explosive gases such as high temperature,	power index: ≥525kW, rated speed: 1480r/min, rated
	High-power flameproof	a small starting current under heavy load conditions. This feature	gas, coal dust, etc. The motor power is \geq 525kW. This	voltage: 3300V (AC).
	switched reluctance motor for	is very consistent with the starting characteristics of the scraper	requirement aims to develop a new motor that can better	
	mining	conveyor. At present, the switched reluctance motor is used in	match the working conditions of scraper conveyor.	
		electric vehicles, textile machinery and other fields, and the		
		power is relatively small. There is no high-power motor suitable		
		for scraper conveyors.		
	AI-driven impact ground pressure simulation software	Combining rock burst numerical simulation with the future	Achieve direct solution of rock mass elastic-plastic	The algorithm model and program code that can realize
		digital and intelligent system platform of coal mines is an	differential equations driven by artificial intelligence,	the simulation of rock burst in "seconds" is no more than
		inevitable trend in the development of rock burst prevention and	establish an artificial intelligence proxy model for rock burst,	50 seconds for 20 million units, and the simulation
		control technology in coal mines. However, the existing	achieve 80% accuracy in simulation of coal and rock mass	accuracy of coal rock deformation and damage is no less
		numerical simulation of rock burst in coal mines mainly relies	deformation and destruction, with a model range of	than 80%.
		on commercial software. First, it fails to simulate the real rock	10km×10km×2km and more than 20 million computing units.	
20		burst phenomenon, and second, it cannot achieve autonomous		
		and controllable simulation. CCTEG developed the first set of		
		rock burst simulation software CoBums in China, which has		
		realized the improvement of rock burst numerical simulation		
		from "hourly" calculation to "minute-level" calculation.		
		However, to further achieve "real-time" calculation, it is		
		necessary to introduce artificial intelligence.		