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Articles are published in Uzbek, Russian, and English, ensuring a wide-reaching audience and fostering cross-cultural academic exchange. As a beacon of academic excellence, the "Journal of Transport" continues to serve as a vital conduit for knowledge dissemination, collaboration, and innovation in the transport sector and related fields.

Scientific analysis of the centralized control system arm DSP bombardier system

Aripova Ch.M.¹

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Abstract: This article presents a scientific analysis of the centralized control system ARM DSP (Bombardier) used at railway stations and its comparison with the relay-based interlocking system. Currently, there are 286 stations within JSC "Uzbekistan Railways," and at 73.4% of these stations, train traffic safety is ensured by control equipment manufactured in the 1960–70s, such as control panels (panel boards), panel manipulators, and external display boards. The conducted analysis has shown that centralized control systems, compared to traditional panel-type control equipment, occupy a leading position in terms of operational reliability and ensuring traffic safety. The use of centralized ARM DSP systems contributes to improving train traffic safety and reducing equipment failures.

Keywords: centralization, ARM DSP, automatic diagnostics, traffic safety, station

Markazlashtirilgan boshqaruv apparati arm DSP bombardier tizimining ilmiy-tahlili

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Annotatsiya: Ushbu maqolada temir yo'l stansiyalaridagi markaziy boqaruv apparati ARM DSP Bombardier tizimining ilmiy tahlili va releli markazlashtirish tizimi bilan taqqoslanishi ko'rsatib o'tilgan. Hozirgi kunda "O'zbekiston temir yo'llarida" AJda 286 ta bekatlar mavjud bo'lib, ushbu bekatlarning 73.4% da poezdlar xarakat xavfsizligini ta'minlashda 60-70 yillarda ishlab chiqilgan boshqaruv apparatlari ya'ni pult-tablo, pult-manipulyatorlar va tashqi tablolaridan foydalanib kelinmoqda. Olib borilgan tahlillar shuni ko'rsatdiki ushbu boshqaruv apparatlari pult tablolaridan markazlashtirilgan boshqaruv apparatlari xarakat xavfsizligini ta'minlashi, ishonchliligi bilan yuqori o'rinni egallaydi. Markazlashtirilgan ARM DSP tizimlaridan foydalanish poezdlar xarakat xavfsizligini ta'minlashga va qurilmalarning nosozliklarining kamayishiga sabab bo'ladi.

Kalit so'zlar: markazlashtirish, ARM DSP avtomatik diagnostika, xarakat xavfsizligi, stansiya

1. Kirish

Temir yo'l transportida harakat xavfsizligi, ekspluatatsiya samaradorligi, xavfsizlik, tezkorlik va ishonchlilik eng muhim omillardan hisoblanadi. Ayniqsa, temir yo'l stansiyalarida poezdlarni qabul qilish va jo'natish, manyovr ishlarini amalga oshirish davomida qurilmalarni aniq va ishonchli boshqarish poezd tarkiblarini to'g'ri yo'nalishlarga tez va xato qilmasdan yo'naltirish uchun juda muhimdir. Hozirgi kunda temir yo'l transportida harakat xavfsizligi, ishonchlilik va boshqaruv samaradorligini oshirish raqamli texnologiyalarni joriy etish bilan chambarchas bog'liq. Shu nuqtai nazardan, poezd harakatini avtomatlashtirilgan tarzda boshqarishni ta'minlovchi ARM DSP tizimlari alohida ahamiyat kasb etadi. Ushbu tizimlar ichida Bombardier Transportation tomonidan ishlab chiqilgan ARM DSP yechimi yuqori xavfsizlik darajasi va funksional imkoniyatlari bilan ajralib turadi [1].

Elektr markazlashtirish releli tizimlarining avtomatlashtirilgan ish joyi (ARM ES) ning qisman yangilanishi.

Stansiya navbatchisi avtomatlashtirilgan ish joyida (ARM DSP) va SSB elektromexanigi avtomatlashtirilgan ish joyida (ARM ShN) boshqarilayotgan ob'ekt haqidagi ma'lumot, uning elementlarining holati, operator tomonidan kiritilayotgan boshqaruv buyruqlari, shuningdek, tizimning ishlashiga oid qo'shimcha ma'lumotlar aks ettiriladi.

Yorug'likning chaqnashi (migayumaya indikatsiya) operator e'tiborini avariya holatiga, nosozlikka, muhim voqeaga yoki yakunlanmagan jarayonga (taklif qiluvchi svetoforni ochish, sun'iy ajratish va h.k.) jalb qilish uchun qo'llaniladi.

Avtomatlashtirilgan ish joyi dasturiy ta'minoti (ARM DSP DT) quyidagi vazifalarni bajarish uchun mo'ljallangan:

–stansiya yo'llarining tarhini, boshqaruv va nazorat ob'ektlarining holati haqidagi ma'lumotlar bilan birga, monitor ekranda mnemonik tasvir ko'rinishida chiqarish;

–ARM ES tizimi tugunlarining diagnostikasi va uning boshqa tizimlar bilan bog'lanishlari, shuningdek yordamchi ma'lumotlarni (ARM DSP DTning ish rejimi, joriy vaqti va h.k.) monitorida chiqarish;



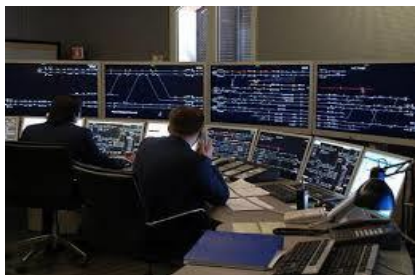
– boshqaruv buyruqlarini kiritish (strelkalarni almashtirish, boshqaruv rejimiga o'tish va h.k.);

– nazorat ob'ektlarida avariya holati yuzaga kelganda signallarni (ovozli va grafik) generatsiya qilish (operator diqqatini jalb etish uchun);

– yordamchi axborotni keng qamrovini o'rnatish.

2. Tadqiqot metodologiyasi

Tizimning funksional imkoniyatlari. Bombardier ARM DSP temir yo'l stansiyalarida poezd harakatini dispatcher tomonidan markazlashgan holda boshqarishni ta'minlaydi. 1-rasm.



1-rasm. Temir yo'l stansiyalarida poezd harakatini ARM DSP dispatcher tomonidan markazlashgan holda boshqarish

Tizim orqali:

- poezd marshrutlarini o'rnatish va bekor qilish;
- strelkalar va svetoforlarni masofadan boshqarish;
- poezdlarning joylashuvini real vaqtda monitoring qilish;
- xavfli marshrutlarning o'zaro kesishishini avtomatik blokirovka qilish;
- nosozlik va favqulodda holatlar haqida ogohlantirish amalga oshiriladi.

Bu funksiyalar inson omili ta'sirini kamaytiradi va boshqaruv qarorlarining aniqligini oshiradi [3].

1-jadval– ARM DSP Bombardier va releli markazlashtirish tizimlarini taqqoslash

No	Taqqoslash mezon	ARM DSP (Bombardier Transportation)	Releli markazlashtirish (MRS)
1	Boshqaruv usuli	Kompyuterlashtirilgan, avtomatlashtirilgan	Elektromexanik, qo'lbola
2	Interfeys	Grafik, vizual, dispatcher qulay	Panel va rele sxemalari
3	Xavfsizlik darajasi	SIL-4 (yuqori xalqaro standart)	Yuqori, ammo zamonaviy standartsiz
4	Inson omili	Minimallashtirilgan	Yuqori darajada ta'sir qiladi
5	Marshrut tekshiruv	Avtomatik mantiqiy algoritmlar	Releli mantiqiy bog'lanish
6	Nosozlikni aniqlash	Avtomatik diagnostika va signal	Qo'lbola aniqlash
7	Ma'lumotlarni saqlash	Raqamli jurnal va arxiv	Qog'oz jurnallar
8	Masofadan boshqarish	Mavjud (markazlashgan)	Aksariyat holda mavjud emas
9	Integratsiya imkoniyati	Zamonaviy IT va telekom tizimlar	Cheklangan
10	Texnik xizmat	Kam mehnat talab qiladi	Ko'p vaqt va mehnat talab etadi
11	Modernizatsiya	Dasturiy yangilanish orqali oson	Qayta qurish talab etiladi
12	Ishonchlik	Yuqori, rezervlashtirilgan	Mexanik eskirish mavjud
13	Joriy etish qiymati	Yuqori	Nisbatan past
14	Ekspluatatsiya xarajati	Uzoq muddatda kam	Uzoq muddatda yuqori

Taqqoslama tahlil natijalari shuni ko'rsatadiki, releli markazlashtirish tizimlari tarixan ishonchli bo'lsa-da, ular zamonaviy raqamli talablarga to'liq javob bermaydi. ARM DSP (Bombardier) tizimi esa yuqori xavfsizlik standarti,

ARM DSP Bombardier tizimi modulli arxitektura asosida qurilgan bo'lib, u quyidagi asosiy qismlardan iborat:

- dispatcher avtomatlashtirilgan ish joyi (grafik interfeys);
- markaziy protsessor yoki interlocking kontrolleri;
- ma'lumot almashinuvini ta'minlovchi raqamli aloqa tarmoqlari;
- ijro mexanizmlari (strelka dvigatellari, svetoforlar va sensorlar).

Tizim kompyuterlashtirilgan interlocking (SBI) tamoyili asosida ishlaydi, bu esa barcha buyruqlarni mantiqiy tekshirishdan o'tkazish imkonini beradi [6].

Bombardier ARM DSP tizimi xalqaro SIL-4 xavfsizlik darajasi talablariga javob beradi. Bu quyidagilar orqali ta'minlanadi:

- barcha marshrutlarning mantiqiy o'zaro bog'liqligi tekshirilishi;
- nosozlik aniqlanganda avtomatik himoya rejimining ishga tushishi;
- boshqaruv buyruqlarini ikkilamchi nazorat qilish;
- barcha amallarning jurnallashtirilishi.

Natijada poezd harakatida avariya holatlari ehtimoli minimal darajaga tushiriladi.

ARM DSP Bombardier tizimining joriy etilishi:

- poezdlarni qabul qilish va jo'natish vaqtini qisqartiradi;
- dispatcher mehnatini yengillashtiradi;
- stansiyaning o'tkazish qobiliyatini oshiradi;
- texnik xizmat ko'rsatish xarajatlarini kamaytiradi.

Bu omillar tizimning iqtisodiy jihatdan ham samarali ekanini ko'rsatadi.

Shu bilan birga, tizimning ayrim cheklovlari mavjud:

- yuqori boshlang'ich investitsiya talab etilishi;
- xizmat ko'rsatish uchun yuqori malakali kadrlarga ehtiyoj;
- mavjud releli markazlashtirish tizimlari.

avtomatik diagnostika, raqamli arxivlash va markazlashgan boshqaruv imkoniyatlari bilan ustunlik qiladi [4].

Shu bilan birga, iqtisodiy jihatdan qaralganda, raqamli tizimlarni joriy etish katta boshlang'ich sarmoya talab qiladi.



Biroq ekspluatatsiya samaradorligi va xavfsizlikning oshishi bu xarajatlarni uzoq muddatda qoplashini ta'minlaydi.

2-jadval

-ARM DSP (Bombardier) va releli MRS tizimlarini taqqoslovchi diagramma

Ko'rsatkich	ARM DSP	Releli MRS
Xavfsizlik	5	4
Avtomatlashuv	5	2
Inson omili	5	2
Diagnostika	5	2
Samaradorlik	5	3
Modernizatsiya	5	1

Baxolash shalasi 1 dan 5 gacha ball:

- 1 — past
- 3 — o'rtacha
- 5 — yuqori

Ushbu ARM DSP va Releli MRS tizimlarining ballar bo'yicha taqqoslash diagrammasidan ko'rinib turibiki Xavfsizlik, inson omili samaradorlik ko'rsatkichlari bo'yicha ARM DSP tizimi yuqori o'rinni egallaydi.

Elektr markazlashtirish releli tizimlarini qisman modernizatsiya qilish dasturiy ta'minotining avfzalliklari:

ARM ES dasturiy ta'minoti elektr markazlashtirish tizimining barcha funksional vazifalarini to'liq bajarilishini ta'minlaydi. Ushbu dasturiy majmua temir yo'l stansiyalarida elektr markazlashtirish qurilmalarini interfeys sxemalari orqali boshqarishga mo'ljallangan bo'lib, poezdlar harakatini releli elektr markazlashtirish tizimlaridagi kabi yuqori xavfsizlik darajasida tashkil etishga xizmat qiladi.

ARM ES dasturiy ta'minoti magistral temir yo'l tarmoqlari hamda sanoat transporti stansiyalarida poezdlar harakatini xavfsiz va ishonchli boshqarish uchun zarur bo'lgan elektr markazlashtirish funksiyalarining to'liq kompleksini bajarishni ta'minlaydi. Ushbu yechim markazlashtirish tizimlarini bosqichma-bosqich modernizatsiya qilish imkonini berib, mavjud releli sxemalarining funksiyalarini saqlagan holda ularning samaradorligini oshiradi.

Stansiya navbatchisi avtomatlashtirilgan ish joyi (ARM DSP) operatoriga qo'yiladigan talablar

ARM DSP operatopi (stansiya nazorati bo'yicha navbatchi) quyidagi bilim va ko'nikmalarga ega bo'lishi lozim:

- shaxsiy kompyuterda ishlash bo'yicha asosiy bilimlarga ega bo'lish;
- ARM DSPdan foydalanish bo'yicha maxsus avvalgi o'quv kursini o'tashi va tegishli ishlar uchun ruxsatnoma olish.

ARM DSPda ish olib borishda stansiya navbatchisi quyidagi hujjatlarning amaldagi nusxalari bilan ish yuritishi shart:

-«O'zbekiston temir yo'llarining texnik foydalanish qoidalarini»;

-«O'zbekiston temir yo'l transportida signalizatsiya bo'yicha yo'riqnomasi (texnik foydalanish qoidalariga №1-ilova)»;

-«O'zbekiston temir yo'l transportida poezdlar harakati va manevr ishlarini tashkil qilish bo'yicha yo'riqnomasi (texnik foydalanish qoidalariga №2-ilova)»;

-«SSB qurilmalari va tizimlarining texnik ekspluatatsiyasida poezdlar harakati xavfsizligini ta'minlash bo'yicha yo'riqnomasi»;

-«Yo'l ishlarini bajarishda poezdlar harakati xavfsizligini ta'minlash bo'yicha yo'riqnomasi»;

-«Temir yo'l kesishmalaridan foydalanish shartlari»;

-«Stansiyaning texnik-tashkiliy akti»;

-«Elektr markazlashtirish releli tizimlarini qisman modernizatsiyalash ARM ES. Ekspluatatsiya qo'llanmasi»;

-«Elektr markazlashtirish releli tizimlarini qisman modernizatsiyalash ARM ES. ARM DSP interfeysi tavsifi. Operator qo'llanmasi»;

-«Elektr markazlashtirish rele tizimlarini qisman modernizatsiyalash ARM ES. ARM DSP ekspluatatsiyasi. Operator qo'llanmasi»;

-«Elektr markazlashtirish rele tizimlarini qisman modernizatsiyalash ARM ES. Shartli grafik tasvirlar. Izohlash yozuvi».

3. Xulosa

Tadqiqot natijalaridan kelib chiqqan holda quyidagi xulosaga kelish mumkin. Releli markazlashtirish tizimlarini bosqichma-bosqich raqamli tizimlar bilan almashtirish iqtisodiy ko'rsatkichlarni yaxshilaydi. Amaldagi releli tizimlarni to'liq almashtirish o'rniga, ARM DSP kabi raqamli tizimlarni bosqichma-bosqich joriy etish iqtisodiy va texnik jihatdan maqbul hisoblanadi. Xavfsizlik standartlariga qat'iy rioya qilish. Tizimni loyihalash va ekspluatatsiya qilishda xalqaro SIL xavfsizlik standartlari talablariga to'liq amal qilinishi shart.

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